Proposed Subdivision
Billy's Lookout - Stages 6 & 9
Site Classification

Fishermans Drive, Teralba

NEW15P-0070A-AJ
15 November 2017

Qualtest
LABORATORY (NSW) PTY LTD

GEOTECHNICAL I LABORATORY I EARTHWORKS I QUARRY I CONSTRUCTION MATERIAL TESTING

15 November 2017

McCloy Development Management Pty Ltd
Suite 1, Level 3, 426 King Street
NEWCASTLE WEST NSW 2309

Attention: Jon Hines

Dear Sir,

RE: PROPOSED SUBDIVISION – BILLY'S LOOKOUT – STAGES 6 & 9
FISHERMANS DRIVE, TERALBA
SITE CLASSIFICATION (LOTS 601 TO 614 & 901 TO 926)

Please find enclosed our geotechnical report for Stages 6 and 9 of the residential subdivision of Billy's Lookout, located at Fishermans Drive, Teralba.

The report provides site classification with respect to reactive soils, in accordance with the requirements of AS2870-2011 '*Residential Slabs and Footings*', Stages 6 and 9 (Lots 601 to 614 and 901 to 926).

If you have any questions regarding this report, please do not hesitate to contact Shannon Kelly or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd

Jason Lee
Principal Geotechnical Engineer

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Attachments:

1.0 Introduction

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this site classification report on behalf of McCloy Development Management Pty Ltd (McCloy), for Stages 6 and 9 of the residential subdivision of Billy's Lookout, located at Fishermans Drive, Teralba.

Based on the brief and drawing provided by the client, Stages 6 and 9 are understood to comprise of 40 residential allotments (Lots 601 to 614 and 901 to 926, respectively).

The scope of work for the geotechnical investigation included providing site classification with respect to reactive soils, in accordance with the requirements of AS2870-2011 '*Residential Slabs and Footings*', for Stages 6 and 9 following completion of site regrade works

This report presents the results of the field work investigations and laboratory testing, and provides recommendations for the scope outlined above.

2.0 Desktop Study

The scope of work has included a review of the following reports completed by Qualtest:

- Site Classification report, 'Proposed Subdivision, Billy's Lookout – Stages 5 to 9, Fishermans Drive, Teralba, (Report Reference: NEW15P-0070A-AA, dated 16 February 2016);
- Site Classification report, 'Proposed Subdivision, Billy's Lookout – Stage 8, Fishermans Drive, Teralba, (Report Reference: NEW15P-0070A-AG, dated 15 March 2017);
- Site Classification report, 'Proposed Subdivision, Billy's Lookout – Stage 5, Fishermans Drive, Teralba, (Report Reference: NEW15P-0070A-AH, dated 11 August 2017);
- Level 1 Site Regrade Assessment report, 'Proposed Subdivision, Billy's Lookout – Stage 9, Fishermans Drive, Teralba, (Report Reference: NEW17P-0090-AA, dated 9 November 2017).
- Level 1 Site Regrade Assessment report, 'Proposed Subdivision, Billy's Lookout – Stage 6, Fishermans Drive, Teralba, (Report Reference: NEW17P-0140-AA, dated November 2017).

This report includes a summary of selected results from the previous reports. Reference should be made to the reports outlined above for further details of site description, subsurface conditions, field work conducted, engineering logs of test pits, laboratory testing results, site supervision and density testing carried out.

3.0 Field Work

Following the completion of site regrade works, additional field work investigations were carried out on 24 October 2017, comprising of:

- Excavation of fourteen test pits (TP601 to TP606 and TP901 to TP908) using a 2.5 tonne tracked excavator with a 0.45m wide toothed bucket, to depths of between 0.25m – 2.10m;
- Undisturbed samples (U50 tubes) were taken for subsequent laboratory testing;
- Test pits were backfilled with the excavation spoil and compacted using the excavator bucket and tracks.

Investigations were carried out by an experienced Geotechnical Engineer from Qualtest who located the test pits, carried out the testing and sampling, produced field logs of the test pits, and made observations of the site surface conditions.

Approximate test pit locations are shown on the attached Figure AJ1, which also includes test pit locations from the previous investigations conducted on site. Engineering logs of the test pits are presented in Appendix A.

The engineer returned to the site on 15 November 2017 to confirm that a temporary fill stockpile that had existed on Lot 908 during the investigation had been removed.

4.0 Site Description

4.1 Site Regrade Works

Site re-grading works were conducted on Lots 601 to 607 for Stage 6 (as shown on Figure AJ1), between the dates 18 January 2017 and 3 August 2017. Site re-grading works were conducted on Lots 918 to 922 for Stage 9 (as shown on Figure AJ1), between the dates of 7 September 2016 and 1 July 2017.

Prior to filling, re-grade areas were stripped of all topsoil and unsuitable material to expose suitable natural residual foundation profile. Re-grade works then consisted of filling with approved site fill to finish design levels.

Filling was performed using site material won from excavations cut from around the site. The fill material could generally be described as mixtures of Gravelly Sandy CLAY, Silty SAND and Clayey SAND, of medium plasticity, fine to coarse grained sand, and with some fine to coarse grained gravel inclusions.

As the geotechnical testing authority engaged for the project, we state that the filling performed for the regrade areas (Lots 601 to 607 and 918 to 922), was carried out to Level 1 criteria as defined in Clause 8.2 – Section 8, of AS3798-2007, '*Guidelines on Earthworks for Commercial and Residential Developments*'.

The recommendations of this report are based on the understanding that any existing lot re-grade works outside the areas shown on Figure AJ1, and described above are limited to cutting and/or placement of fill including topsoil to depths of less than 0.4m, in general accordance with the design. Qualtest should be informed without delay if additional earthworks are known to have been carried out.

4.2 Surface Conditions

Selected photographs of the site taken on the day of the site investigations are shown below.

Photograph 1: Facing southwest from near TP606, Fishermans Drive in background.

Photograph 2: Facing west from near TP606.

Photograph 3: Facing west from TP908 (along the boundary of Lots 901 & 902), showing Castaway Crescent in background.

Photograph 4: Facing northwest from TP908 (along the boundary of Lots 901 & 902).

Photograph 5: Facing northwest from near eastern corner of Lot 906.

Photograph 6: Facing north from near north-eastern corner of Lot 906.

4.3 Subsurface Conditions

Reference should be made to the previous reports outlined in Section 2.0 for full details of site description, subsurface conditions, field work conducted, engineering logs of test pits, laboratory testing results, site supervision and density testing carried out.

Reference to the 1:100,000 Newcastle Coalfield Regional Geology Sheet indicates the site to be underlain by the Clifton Subgroup of the Narrabeen Group, and the Moon Island Beach Subgroup of the Newcastle Coal Measures, which are characterised by Conglomerate, Sandstone, Siltstone, Claystone, Tuff and Coal rock types.

Table 1 presents a summary of the typical soil types encountered on site during the field investigations, divided into representative geotechnical units. The units adopted have typically remained consistent with those previously provided, with the addition of Controlled Fill.

Table 2 contains a summary of the distribution of the above geotechnical units at the test pit locations.

No groundwater levels or water inflows were encountered in the test pits during the limited time that they remained open on the day of the field investigation.

It should be noted that groundwater conditions can vary due to rainfall and other influences including regional groundwater flow, temperature, permeability, recharge areas, surface condition, and subsoil drainage.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES

Unit	Soil Type	Description
1A	FILL – TOPSOIL & MULCH	Generally up to about 50mm of mulch, overlying Silty SAND / Clayey SAND - fine to coarse grained, dark grey to grey, fines of low to medium plasticity, with some fine to medium grained gravel.
1B	CONTROLLED FILL	Sandy CLAY – medium and low to medium plasticity, dark grey-brown, orange-brown to dark orange and pale grey-white, fine to coarse grained sand, with some fine to medium grained sub-angular to sub-rounded gravel and trace cobbles in places. SAND – fine to coarse grained, grey. Clayey SAND – fine to coarse grained, grey to grey-brown, fines of low to medium plasticity, trace fine to medium grained sub-rounded to sub-angular gravel.
2	TOPSOIL	Silty SAND - fine to coarse grained, grey, fines of low plasticity, root affected. Clayey SAND - fine to coarse grained, dark brown to grey, fines of medium plasticity, root affected.
3	SLOPEWASH / COLLUVIUM	Silty SAND, SAND - fine to medium grained, pale brown / grey, some Silt / fines of low plasticity. Clayey SAND - fine to coarse grained, dark brown to grey, fines of medium plasticity.
4	RESIDUAL SOIL	CLAY / Sandy CLAY – medium and medium to high plasticity, variable colours such as pale brown, orange to pale brown, pale grey, grey, and brown to red, some sand / fine to coarse grained sand. Clayey SAND / SAND – fine to coarse grained, orange-brown and pale grey-white, with clay / fines of low to medium plasticity, trace fine to medium grained sub-angular to sub-rounded gravel.
5	EXTREMELY WEATHERED (XW) ROCK	Extremely Weathered SANDSTONE with Soil Properties; excavating as SAND – fine to coarse grained, pale grey-white and orange-brown to orange, with some clay. Breaks down into Clayey SAND in places.
6	HIGHLY WEATHERED (HW) ROCK	SANDSTONE - fine to coarse grained, variable colours such as pale grey to white, grey, orange, pale brown, variable estimated strength ranging from low to high. Sandy SILTSTONE – pale orange-brown to brown and pale grey, estimated medium strength, with some Extremely Weathered pockets.

TABLE 2 – SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED AT TEST PIT LOCATIONS

TEST PIT NO.	UNIT 1A Fill – Mulch & Topsoil	UNIT 1B Fill - Controlled	UNIT 2 Topsoil	Unit 3 Slopewash Colluvium	Unit 4 Residual Soil	Unit 5 XW Rock	Unit 6 HW Rock
	Depth (m)						
Current Geotechnical Assessment (Ref: NEW15P-0070A-AJ, November 2017)							
TP601	-	-	0.00 - 0.25	-	-	-	0.25 - 0.35*
TP602	0.00 - 0.20	-	-	-	0.20 - 0.25	-	0.25 - 0.27*
TP603	-	-	0.00 - 0.10	0.10 - 0.40	0.40 - 0.70	-	0.70 - 0.80*
TP604	0.00 - 0.03	-	-	0.03 - 0.15	0.15 - 1.00	1.00 – 1.60^	-
TP605	0.00 - 0.15	-	-	-	0.30 - 2.00^	-	-
TP606	0.00 - 0.40	-	-	0.40 - 0.60	0.60 - 1.70	-	1.70 - 1.72*
TP901	0.00 - 0.20	0.20 - 0.90	-	-	0.90 - 2.10	-	-
TP902	0.00 - 0.07	0.07 - 0.50	-	-	0.50 - 1.10	-	1.10 - 1.20*
TP903	0.00 - 0.20	-	-	-	-	-	0.20 - 0.25*
TP904	0.00 - 0.20	-	-	-	-	0.20 – 0.30	0.30 - 0.40^
TP905	0.00 - 0.30	-	-	0.30 - 0.50	0.50 - 0.90	-	0.90 - 0.95*
TP906	0.00 - 0.25	-	-	-	-	-	0.25 - 0.30*
TP907	0.00 - 0.35	-	-	-	0.35 - 0.40	-	0.40 - 0.90*
TP908	0.00 - 0.20	-	-	-	0.20 - 0.40	-	0.40 - 0.60^
Previous Investigations (February 2016, June 2016, March 2017 & August 2017)							
TP118	-	-	0.00 - 0.35	-	0.35 - 1.50	-	1.50 - 1.70#
TP206	-	-	0.00 - 0.22	0.22 - 0.40	0.40 - 1.60	-	1.60 - 1.80
TP208	-	-	0.00 - 0.27	0.27 - 0.45	0.45 - 1.40	-	1.40 - 1.70^
TP210	-	-	0.00 - 0.10	0.10 - 0.38	0.38 - 0.80	0.80 - 1.30	1.30 - 1.50^
TP212	-	-	0.00 - 0.20	0.20 - 0.45	0.45 - 1.00	-	1.00 - 1.40^
BH804	0.00 - 0.20	0.20 - 0.90	-	-	0.90 - 1.50	-	-
BH809	0.00 - 0.20	0.20 – 1.10	-	-	1.10 - 1.50	-	.
TP5-5	0.00 - 0.25	0.25 - 1.20	-	-	1.20 - 1.40	-	-
TP5-7	0.00 - 0.25	0.25 - 1.80	-	-	-	-	-
TP5-8	0.00 - 0.25	0.25 - 1.60	-	1.60 - 1.75	1.75 - 1.90	-	-

Notes:

***** = Practical refusal or refusal of 2.5 tonne excavator met on Highly Weathered Rock (current investigation November 2017).

= Practical refusal or refusal of 22 tonne excavator met on Highly Weathered Rock (preliminary investigation Feb 2016).

^ = Slow to very slow progress, close to practical excavator refusal.

5.0 Laboratory Testing

Samples collected during the field investigations were returned to our NATA accredited Warabrook Laboratory for testing which comprised of:

- (6 no.) Atterberg Limits tests;
- (4 no.) Shrink / Swell tests;

Results of the laboratory testing have been kept on file for reference, with a summary of the Atterberg limits and Shrink/Swell results presented respectively in Tables 3 and 4.

The tables also include a summary of laboratory testing information (where applicable) from the previous Geotechnical Assessment works carried out by Qualtest.

TABLE 3 – SUMMARY OF ATTERBERG LIMITS TESTING RESULTS

Location	Depth (m)	Material Description	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
Current Investigation (November, 2017)						
TP602	0.20 – 0.25	(SC) Clayey SAND	27	17	10	3.5
TP603	0.50 – 0.70	(CL) Sandy CLAY	37	17	20	6.0
TP604	0.70 – 0.90	(CH) Sandy CLAY	60	17	43	9.5
TP901	0.10 – 0.20	FILL: (SC) Clayey SAND	15	12	3	1.0
TP903	0.10 – 0.20	FILL: (SC) Clayey SAND	23	15	8	3.0
TP904	0.20 – 0.30	(SC) Clayey SAND	23	18	5	2.0
TP905	0.40 – 0.50	(SC) Clayey SAND	37	17	20	9.0
TP906	0.10 – 0.20	FILL: (SC) Clayey SAND	29	16	13	4.0
TP907	0.10 – 0.30	FILL: (SC) Clayey SAND	23	16	7	2.5
TP908	0.20 – 0.40	(CI) Sandy CLAY	44	18	26	5.5
Previous Investigation (March 2017)						
BH804	0.60 - 0.90	(CL) Gravelly Sandy CLAY	29	12	17	5.0
BH809	0.20 - 0.60		25	14	11	3.0

TABLE 4 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

Location	Depth (m)	Material Description	I_{ss} (%)
Current Investigation (November 2017)			
TP605	0.70 – 1.00	(CH) CLAY - Residual	2.7
TP606	0.65 – 0.80	(CH) CLAY - Residual	3.0
TP901	1.00 – 1.30	(CH) Sandy CLAY - Residual	3.3
TP902	0.80 – 0.95	(CH) CLAY - Residual	4.8
Previous Investigations (June 2016 & August 2017)			
TP5-5	0.40 - 0.80	(CH) Sandy CLAY- Fill	0.9
TP5-7	0.50 - 0.80	(CH) Sandy CLAY- Fill	2.0
TP5-8	0.40 - 0.80	(CH) Sandy CLAY- Fill	2.0
TP206	0.55 - 0.70	(CI) Sandy CLAY- Residual	2.1
TP208	0.50 - 0.90	(CI) Sandy CLAY - Residual	1.5
TP210	0.50 - 0.65	(CL) Sandy CLAY- Residual	0.6
TP212	0.60 - 0.76	(CL) Sandy CLAY- Residual	0.7

6.0 Site Classification to AS2870-2011

Based on the results of the field work, laboratory testing, and Level 1 site supervision and testing carried out, residential lots located within the proposed Stages 6 and 9 of the Billy's Lookout subdivision located Fishermans Drive, Teralba, as shown on Figure AJ1, are classified in their current condition in accordance with AS2870-2011 *'Residential Slabs and Footings'*, as shown in Table 5.

TABLE 5 – SITE CLASSIFICATION TO AS2870-2011

Stage	Lot Numbers	Site Classification	Estimated Characteristic Free Surface Movement
6	607 to 614	**M**	20mm to 40mm
	601 to 606	**H1**	40mm to 60mm
9	901 to 917, 922 to 926	**M**	20mm to 40mm
	918 to 921	**H1**	40mm to 60mm

Characteristic free surface movements have been estimated for lots in their existing condition as shown in Table 5.

The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement.

If site re-grading works involving cutting or filling are performed after the date of this assessment the classification may change and further advice should be sought.

Final site classification will be dependent on the type of fill and level of supervision carried out. Re-classification of lots should be confirmed by the geotechnical authority at the time of construction following any site re-grade works.

Footings for the proposed development should be designed and constructed in accordance with the requirements of AS2870-2011.

The classification presented above assumes that:

- All footings are founded in controlled fill (if applicable) or in the residual clayey soils or rock below all non-controlled fill, topsoil material and root zones, and fill under slab panels meets the requirements of AS2870-2011, in particular, the root zone must be removed prior to the placement of fill materials beneath slabs.
- The performance expectations set out in Appendix B of AS2870-2011 are acceptable, and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.
- Footings are to be founded outside of or below all zones of influence resulting from existing or future service trenches.
- The constructional and architectural requirements for reactive clay sites set out in AS2870-2011 are followed.
- Adherence to the detailing requirement outlined in Section 5 of AS2870-2011 '*Residential Slabs and Footings*' is essential, in particular Section 5.6, '*Additional requirements for Classes M, H1, H2 and E sites*' including architectural restrictions, plumbing and drainage requirements.
- Site maintenance complies with the provisions of CSIRO Sheet BTF 18, "*Foundation Maintenance and Footing Performance: A Homeowner's Guide*", a copy of which is attached in Appendix C.

All structural elements on all lots regardless of their site classification should be supported on footings founded beneath all uncontrolled fill, layers of inadequate bearing capacity, soft/loose, or other potentially deleterious material.

If any areas of uncontrolled fill of depths greater than 0.4m are encountered during construction, footings should be designed in accordance with engineering principles for Class 'P' sites.

7.0 Limitations

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practices and standards. To our knowledge, they represent a reasonable interpretation of the general conditions of the site.

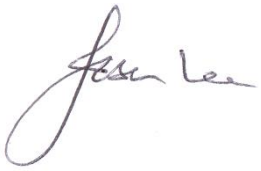
The extent of testing associated with this assessment is limited to discrete test pit locations. It should be noted that subsurface conditions between and away from the test pit locations may be different to those observed during the field work and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during construction differ from those given in this report, further advice should be sought without delay.

Data and opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement by Qualtest. If this report is reproduced, it must be in full.

If you have any further questions regarding this report, please do not hesitate to contact Shannon Kelly or the undersigned.

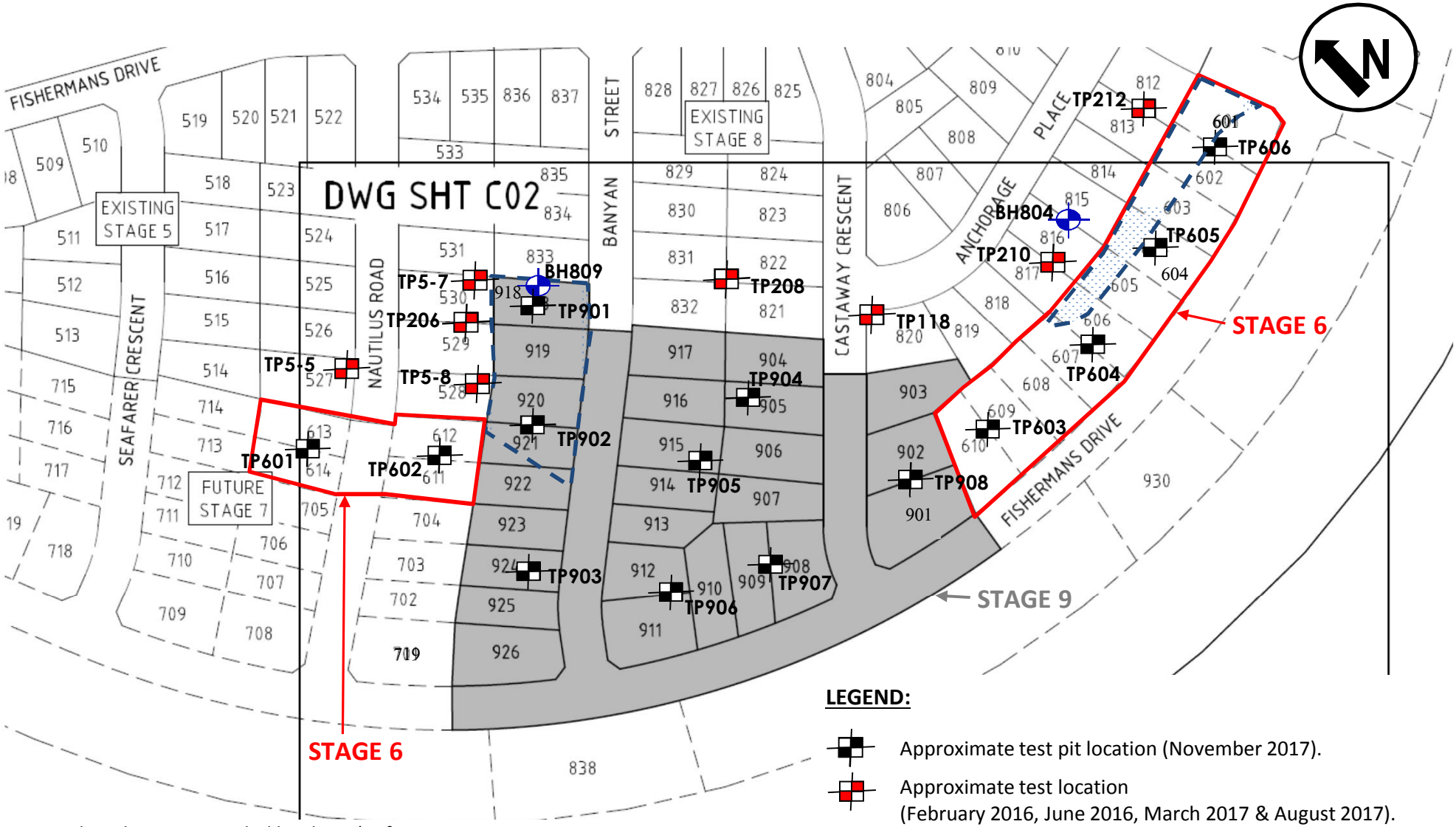
For and on behalf of Qualtest Laboratory (NSW) Pty Ltd.



Jason Lee
Principal Geotechnical Engineer

FIGURES:

Figure AJ1 –Approximate Test Location Plan



LEGEND:

- Approximate test pit location (November 2017).
- Approximate test location (February 2016, June 2016, March 2017 & August 2017).
- Inferred area of Site Regrade (Controlled Fill).

Based on drawing provided by client (Ref: Project No. 16545C, Drawing No. C01, Revision No. 1, dated: 18/11/2016, by Geoff Craig & Associates Pty Ltd).

Qualtest LABORATORY (NSW) PTY LTD

Client:	McCLOY DEVELOPMENT MANAGEMENT PTY LTD	Drawing No:	FIGURE AJ1
Project:	PROPOSED SUBDIVISION - BILLY'S LOOKOUT - STAGES 6 & 9	Project No:	NEW15P-0070A
Location:	FISHERMANS DRIVE, TERALBA	Scale:	NOT TO SCALE
Title:	APPROXIMATE TEST PIT LOCATION PLAN	Date:	15-11-2017

APPENDIX A:

Engineering Logs of Test Pits

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP601

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.25m D 0.35m				SM	TOPSOIL: Silty SAND - fine to coarse grained, grey, fines of low plasticity, root affected. 0.25m SANDSTONE - fine to coarse grained, red-brown and pale grey, estimated medium strength. 0.35m Hole Terminated at 0.35 m Practical Refusal	D				TOPSOIL HIGHLY WEATHERED ROCK

0.5
1.0
1.5
2.0

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP602

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.20m 0.25m D				SM SP	0.05m FILL: TREE MULCH FILL: TOPSOIL- Silty SAND - fine to coarse grained, dark grey, fines of low plasticity, with some fine to medium grained sub-angular to sub-rounded gravel, root affected. 0.20m 0.25m Clayey SAND - fine to coarse grained, orange-brown and pale grey-white, trace fine to medium grained sub-angular to sub-rounded gravel. 0.27m SANDSTONE - fine to coarse grained, pale orange-brown and pale grey-white, estimated medium to high strength. Hole Terminated at 0.27 m Practical Refusal	M D	D			FILL - MULCH FILL - TOPSOIL RESIDUAL SOIL / POSSIBLE COLLUVIUM HIGHLY WEATHERED ROCK

0.5
1.0
1.5
2.0

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP603
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered					SM	TOPSOIL: Silty SAND - fine to coarse grained, grey-brown, fines of low plasticity, root affected.	M				TOPSOIL
							0.10m					
						SP	SAND - fine to coarse grained, grey-brown, with some silt.	D	D			COLLUVIUM
							0.40m					
		0.50m		0.5		CL	Sandy CLAY - low to medium plasticity, orange-brown and pale grey, fine to coarse grained sand.	M < w_P	VSt	HP	320	RESIDUAL SOIL
		D										
		0.70m					0.70m					
							SANDSTONE - fine to coarse grained, pale orange-brown and pale grey, estimated medium strength.	D				HIGHLY WEATHERED ROCK
							0.80m					
							Hole Terminated at 0.80 m Practical Refusal					
				1.0								
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP604
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
							0.03m FILL: TREE MULCH	M				FILL: MULCH
						SM	Silty SAND - fine to coarse grained, grey, fines of low plasticity.					SLOPE WASH / TOPSOIL
							0.15m Clayey SAND - fine to coarse grained, orange-brown to brown, fines of medium plasticity.					RESIDUAL SOIL / POSSIBLE COLLUVIUM
		0.20m										
		D						D	D			
		0.40m				SC						
				0.5								
							0.60m					
							Sandy CLAY - medium to high plasticity, red-brown and grey, fine to coarse grained sand, with fine to medium grained sub-angular gravel.					RESIDUAL SOIL
E	Not Encountered	0.70m				CH		M < w_P	H	HP	>600	
		D										
		0.90m										
				1.0			1.00m			HP	>600	
							Extremely Weathered SANDSTONE with Soil Properties; breaks down into Sandy CLAY - medium plasticity, red-brown and grey, fine to coarse grained sand, with fine to medium grained sub-angular gravel.					EXTREMELY WEATHERED ROCK
						CI		D - M	VD			
				1.5			1.60m					
							Hole Terminated at 1.60 m Slow progress					
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP605
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.70m U50 1.00m		0.5 1.0 1.5 2.0		SC Cl CH	0.02m FILL: TREE MULCH FILL: TOPSOIL - Clayey SAND - fine to coarse grained, dark grey-brown, fines of low to medium plasticity, trace fine to medium grained sub-angular to sub-rounded gravel. 0.15m FILL: Sandy CLAY - medium plasticity, orange-brown with some dark-orange and pale grey-white, fine to coarse grained sand, with some fine to medium grained sub-angular to sub-rounded gravel. 0.30m CLAY - high plasticity, orange-brown to orange and grey to pale grey, with some fine to medium grained sand. Becoming pale orange-brown and pale grey-white. 2.00m Hole Terminated at 2.00 m Slow progress	D - M M M > w_P	MD - D St VSt VSt - H	HP HP HP HP HP HP HP HP HP	120 360 320 320 320 270 420 380 - 420 380 420	FILL - MULCH FILL - TOPSOIL CONTROLLED FILL RESIDUAL SOIL

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP606

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.65m U50 0.80m		0.5 1.0 1.5 2.0		SC SP CH CH	0.04m FILL: TREE MULCH FILL-TOPSOIL: Clayey SAND - fine to coarse grained, grey to grey-brown, fines of low to medium plasticity, trace fine to medium grained sub-rounded to sub-angular gravel, trace rootlets. 0.40m SAND - fine to coarse grained, grey. 0.60m CLAY - high plasticity, orange-brown with some fine to coarse grained sand. Becoming orange-brown to dark orange with some pale grey-white. Increasing in sand content. 1.20m Sandy CLAY - medium to high plasticity, pale orange and pale grey-white, fine to coarse grained sand. 1.70m 1.72m SANDSTONE - fine to coarse grained, pale grey-white and pale orange, estimated high strength. Hole Terminated at 1.72 m Practical Refusal	M M > w_P M < w_P D	MD - D D VSt H D	HP HP HP HP	300 390 420 420	FILL - MULCH FILL: TOPSOIL COLLUVIUM RESIDUAL SOIL HIGHLY WEATHERED ROCK

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP901
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
							0.05m FILL: TREE MULCH					FILL - MULCH
		0.10m				SC	FILL: TOPSOIL - Clayey SAND - fine to coarse grained, dark grey, fines of low to medium plasticity, with some fine to medium grained sub-angular to	M				FILL: TOPSOIL
		D 0.20m					0.20m sub-rounded gravel.					
							FILL: Sandy CLAY - low to medium plasticity, orange-brown and pale grey, fine to coarse grained sand, trace fine to coarse grained sub-angular gravel, trace cobbles.					CONTROLLED FILL
				0.5		CL						
									VSt			
							0.90m					
							Sandy CLAY - medium to high plasticity, orange-brown with some grey, fine to coarse grained sand.					RESIDUAL SOIL
E	Not Encountered	1.00m		1.0						HP	250	
										HP	280	
		U50						M > w_P				
		1.30m								HP	420	
							Becoming pale grey and red-brown.					
				1.5		CH						
										HP	480	
									H			
				2.0								
							2.10m					
							Hole Terminated at 2.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP902

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
E	Not Encountered					SC	0.02m FILL: TREE MULCH 0.07m	M				FILL - MULCH
							FILL: TOPSOIL - Clayey SAND - fine to coarse grained, dark grey, fines of low to medium plasticity, with some fine to medium grained sub-angular to sub-rounded gravel.	$M \sim w_P$ - $M > w_P$				FILL - TOPSOIL
						CI	FILL: Sandy CLAY - medium plasticity, orange-brown and pale grey, fine to coarse grained sand, trace fine to medium grained sub-angular gravel, with clayey Sand pockets.		H	HP	420 - >600	CONTROLLED FILL
				0.5			0.50m CLAY - high plasticity, pale brown to grey.					RESIDUAL SOIL
										HP	180	
									St	HP	180	
		0.80m				CH		$M > w_P$		HP	150	
		U50 0.95m								HP	150	
				1.0					VSt	HP	220 - 250	
							1.10m			HP	250	HIGHLY WEATHERED ROCK
							SANDSTONE - fine to coarse grained, orange-brown to red-brown and pale grey, estimated high strength. Iron stained in places. 1.20m	D				
							Hole Terminated at 1.20 m Very slow progress					
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP903

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered						0.05m FILL: TREE MULCH	M				FILL - MULCH
						SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey, fines of low to medium plasticity, with some fine to medium grained sub-angular to sub-rounded gravel.	M - W				FILL - TOPSOIL
							0.20m 0.25m SANDSTONE - fine to coarse grained, pale orange-brown and pale grey-white, estimated medium to high strength.	D	VD			HIGHLY WEATHERED ROCK
							Hole Terminated at 0.25 m Practical Refusal					

0.5
1.0
1.5
2.0

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP904
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.20m D 0.30m				SC	0.03m FILL-MULCH: TREE MULCH. FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey-brown, fines of low to medium plasticity, with fine to medium grained sub-angular gravel.	M - W				FILL - MULCH FILL: TOPSOIL
						SC	0.20m Extremely Weathered SANDSTONE with soil properties; breaks down into Clayey SAND - fine to coarse grained, pale grey-white and orange-brown.	D	D			EXTREMELY WEATHERED ROCK
				0.5			0.30m SANDSTONE - fine to coarse grained, pale grey-white and orange-brown to orange, estimated low to medium strength.	D	VD			HIGHLY WEATHERED ROCK
				1.0			0.40m Hole Terminated at 0.40 m Very slow progress					
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP905

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
E	Not Encountered	0.40m D 0.50m 0.60m D 0.80m		0.5		SC	0.02m FILL: TREE MULCH FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey, fines of low to medium plasticity, with some fine to medium grained sub-angular to sub-rounded gravel.	M - W				FILL - MULCH FILL - TOPSOIL
						SC	0.30m Clayey SAND - fine to coarse grained, orange-brown and pale grey, fines of low to medium plasticity, weakly cemented, with some fine to medium grained sub-angular to sub-rounded gravel.	M	D			COLLUVIUM
						CL	0.50m Sandy CLAY - low to medium plasticity, orange-brown with some pale grey, fine to coarse grained sand.	M > w_P	H	HP	>600	RESIDUAL SOIL
				1.0			0.90m 0.95m SANDSTONE - fine to coarse grained, pale orange-brown and pale grey-white, estimated medium to high strength. Hole Terminated at 0.95 m Practical Refusal	D	VD			HIGHLY WEATHERED ROCK
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP906

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
JOB NO: NEW15P-0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.10m D 0.20m				SC	0.02m FILL: TREE MULCH FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey, fines of low to medium plasticity, with some fine to medium grained sub-angular to sub-rounded gravel.	D - M				FILL - MULCH FILL - TOPSOIL
							0.25m 0.30m SANDSTONE - fine to medium grained, pale orange-brown and pale grey-white, estimated medium to high strength.	D	D - VD			HIGHLY WEATHERED ROCK
				0.5			Hole Terminated at 0.30 m Practical Refusal					
				1.0								
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP907
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.10m D 0.30m				SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey-brown, fines of low to medium plasticity, with some fine to medium grained sub-angular to sub-rounded gravel.	M				FILL - TOPSOIL
							0.35m					
						CL	0.40m Sandy CLAY - low to medium plasticity, pale orange-brown and pale grey, with fine to medium grained sub-angular gravel (Siltstone fragments).	M > w_P	VSt	HP	300	RESIDUAL SOIL
				0.5			Sandy SILTSTONE - pale orange-brown to brown and pale grey, estimated medium strength with extremely weathered pockets.	D - M				HIGHLY WEATHERED ROCK
							Becoming less weathered.	D				
							0.90m Hole Terminated at 0.90 m Practical Refusal					
				1.0								
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY DEVELOPMENT MANAGEMENT
PROJECT: PROPOSED SUBDIVISION - STAGES 6 & 9
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP908
PAGE: 1 OF 1
JOB NO: NEW15P-0070A
LOGGED BY: BE
DATE: 24/10/17

EQUIPMENT TYPE: 2.5 TONNE EXCAVATOR
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	D 0.20m				SM	FILL-TOPSOIL: Silty SAND - fine to coarse grained, dark grey-brown, fines of low plasticity, trace fine to medium grained sub-angular to sub-rounded gravel, trace cobbles, root affected. Tree mulch in top 0.02m.	M				FILL - TOPSOIL
		D 0.40m				CI	0.20m Sandy CLAY - medium plasticity, orange-brown to brown, fine to coarse grained sand.	M > w_P	H	HP	>600	RESIDUAL SOIL
				0.5			0.40m SANDSTONE - fine to coarse grained, pale orange-brown and pale grey-white, estimated medium to high strength.	D				HIGHLY WEATHERED ROCK
				1.0			0.60m Hole Terminated at 0.60 m Very slow progress					
				1.5								
				2.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP118

CLIENT: MCCLOY GROUP DEVELOPMENT MANAGEMENT PTY LTD **PAGE:** 1 OF 1

PROJECT: PROPOSED SUBDIVISION - STAGES 5 TO 9 **JOB NO:** NEW15P-0070A

LOCATION: PITT STREET, TERALBA **LOGGED BY:** SJK

DATE: 12-1-16

EQUIPMENT TYPE: 22 tonne excavator **SURFACE RL:** 24.0 m

TEST PIT LENGTH: 3.0 m **WIDTH:** 1.5 m **DATUM:** Assumed

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered					SM	Silty SAND - fine to coarse grained, brown to grey, fines of low plasticity, root affected.	M				TOPSOIL
		0.40m					0.35m					
		CBR	23.5	0.5		CI	CLAY - medium plasticity, pale brown to orange with grey and brown to red, some fine to medium grained sand, some tree roots.		St	HP	180	RESIDUAL SOIL
		0.80m					0.80m					
			23.0	1.0		CI	Sandy CLAY - medium plasticity, pale grey and brown to red, fine to coarse grained sand. Some weakly cemented pockets / nodules.	$M > w_P$	VSt	HP	350	
									H	HP	500	
			22.5	1.5			1.50m					
							SANDSTONE - mostly fine to medium grained, pale grey to white and orange, estimated medium to high strength becoming high strength.	M				HIGHLY WEATHERED ROCK
							1.70m					
							Hole Terminated at 1.70 m Practical Refusal					
			22.0	2.0								
			21.5	2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP206

CLIENT: McCLOY TERALBA
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGE 8
JOB NO: NEW15P - 0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 13-5-16

EQUIPMENT TYPE: KOBELCO - 5.5 Tonne Excavator
SURFACE RL: 28.5 m
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.3 m
DATUM: Assumed

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered		28.5	0.0		SM	Silty SAND - fine to medium grained, grey, root affected.	D - M				TOPSOIL
				0.22m		SP	SAND - fine to medium grained, grey, trace of silt.		MD - D			COLLUVIUM
				0.40m			Sandy CLAY - medium to high plasticity, orange and orange brown, fine to medium grained sand.					RESIDUAL SOIL
		0.55m	28.0	0.5						HP	>600	
		U50 0.70m										
			27.5	1.0		CH		M < w_P	H	HP	>600	
							Becoming red-brown and grey.			HP	>600	
			27.0	1.5								
				1.60m			SANDSTONE - fine to medium grained, fines of low plasticity, estimated very low to low strength.					EXTREMELY TO HIGHLY WEATHERED ROCK
				1.80m			Hole Terminated at 1.80 m Very slow progress					
			26.5	2.0								
			26.0	2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY TERALBA
PROJECT: PROPOSED SUBDIVISION - STAGE 8
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP208
PAGE: 1 OF 1
JOB NO: NEW15P - 0070A
LOGGED BY: BE
DATE: 13-5-16

EQUIPMENT TYPE: KOBELCO - 5.5 Tonne Excavator
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.3 m
SURFACE RL: 24.0 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered					SM	Silty SAND - fine to medium grained, grey, root affected.	D - M				TOPSOIL
							0.27m					
						SP	SAND - fine to medium grained, grey and yellow-brown, trace of fine to medium grained gravel, sub-rounded.		MD - D			COLLUVIUM / RESIDUAL
							0.45m					
		0.50m	23.5	0.5			Sandy CLAY - medium to high plasticity, orange and orange-brown, fine to medium grained sand.					RESIDUAL SOIL
		U50								HP	>600	
		0.90m					Becoming red-brown and grey.					
			23.0	1.0		CH		M < w_P	H	HP	>600	
							1.40m					
			22.5	1.5			SANDSTONE - fine to medium grained, red-brown and grey, estimated very low to low strength, strength increasing with depth.					EXTREMELY TO HIGHLY WEATHERED ROCK
							1.70m					
							Hole Terminated at 1.70 m Very slow progress					
			22.0	2.0								
			21.5	2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY TERALBA
PROJECT: PROPOSED SUBDIVISION - STAGE 8
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP210
PAGE: 1 OF 1
JOB NO: NEW15P - 0070A
LOGGED BY: BE
DATE: 13-5-16

EQUIPMENT TYPE: KOBELCO - 5.5 Tonne Excavator
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.3 m
SURFACE RL: 22.0 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered					SM	Silty SAND - fine to medium grained, grey, root affected.					TOPSOIL
							0.10m Silty SAND - fine to medium grained, grey.	D - M	MD - D			COLLUVIUM
						SP	Trace of fine grained tree roots.					
							0.38m Sandy CLAY - low to medium plasticity, orange to orange-brown, fine to medium grained sands.					RESIDUAL SOIL
		0.50m	21.5	0.5		CL		M < w_P	H	HP	>600	
		U50 0.65m					0.80m Extremely Weathered SANDSTONE with soil propoerties, breaks down into Clayey SAND - fine to medium grained, red-brown to orange and grey, fines of low plasticity, with fine to medium grained gravel (sandstone fragments).					EXTREMELY WEATHERED ROCK
			21.0	1.0		SC		D - M	D - VD	HP	>600	
							Becoming highly weathered.					
			20.5	1.5			1.50m Hole Terminated at 1.50 m Very slow progress					
			20.0	2.0								
			19.5	2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP212

CLIENT: McCLOY TERALBA
PAGE: 1 OF 1
PROJECT: PROPOSED SUBDIVISION - STAGE 8
JOB NO: NEW15P - 0070A
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BE
DATE: 13-5-16

EQUIPMENT TYPE: KOBELCO - 5.5 Tonne Excavator
SURFACE RL: 19.0 m
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.3 m
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.60m U50 0.76m	18.5	0.5		SM	Silty SAND - fine to medium grained, grey, root affected.					TOPSOIL
							0.20m Silty SAND - fine to medium grained, grey.	D - M	D			COLLUVIUM/SLOPE WASH
						SM	0.45m					
						SC	Sandy CLAY - low to medium plasticity, dark orange and grey, fine to medium grained sand.	M < w_P	H	HP	>600	RESIDUAL SOIL
							Becoming red-brown and grey, trace of fine to medium grained sandstone gravel, sub-angular			HP	>600	
			18.0	1.0			1.00m SANDSTONE - fine to medium grained, red-brown and grey, estimated very low to low strength.	M				HIGHLY WEATHERED ROCK
							Strength increasing with depth.					
							1.40m Hole Terminated at 1.40 m Very slow progress					
			17.5	1.5								
			17.0	2.0								
			16.5	2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY TERALBA
PROJECT: PROPOSED SUBDIVISION - STAGE 5
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP5-5
PAGE: 1 OF 1
JOB NO: NEW15P - 0070A
LOGGED BY: SJK
DATE: 28/7/17

EQUIPMENT TYPE: CASE BACKHOE 580ST
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
BH	Not Encountered						0.05m FILL: MULCH - grey to brown	M				FILL - MULCH
						SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, grey, fines of low to medium plasticity, with some fine to medium grained gravel and organics.	M - W				FILL - TOPSOIL
							0.25m FILL: Sandy CLAY - medium to high plasticity, pale brown to orange, brown to red, pale grey, fine to coarse grained sand, some fine to coarse grained sub-angular gravel.			HP	350	CONTROLLED FILL
		0.40m		0.5						HP	350	
		U50				CH		$M > w_P$	VSt			
		0.80m		1.0								
							1.20m					
						CH	CLAY - medium to high plasticity, pale brown with brown to red and grey, with some fine to medium grained sand.		St - VSt	HP	200	RESIDUAL SOIL
							1.40m Hole Terminated at 1.40 m					
				1.5								
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY TERALBA
PROJECT: PROPOSED SUBDIVISION - STAGE 5
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP5-7
PAGE: 1 OF 1
JOB NO: NEW15P - 0070A
LOGGED BY: SJK
DATE: 28/7/17

EQUIPMENT TYPE: CASE BACKHOE 580ST
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
BH	Not Encountered						0.05m FILL: MULCH - grey to brown.					FILL - MULCH
						SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, grey, fines of low to medium plasticity, with some fine to medium grained gravel and organics.	M				FILL - TOPSOIL
							0.25m					
		0.50m		0.5			FILL: Sandy CLAY - medium to high plasticity, pale grey and pale brown to orange with brown to red, fine to medium grained sand, with small pockets of Clayey SAND.			HP	180	CONTROLLED FILL
		U50				CH		$M > w_P$	St - VSt			
		0.80m		1.0						HP	230	
							1.40m					
				1.5		CI	FILL: Silty Gravelly SAND - fine to coarse grained, pale brown, fine to medium grained sub-rounded gravel, fines of low plasticity.	M	MD - D			CONTROLLED FILL possibly COLLUVIUM
							1.80m					
							Hole Terminated at 1.80 m					
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - TEST PIT

CLIENT: McCLOY TERALBA
PROJECT: PROPOSED SUBDIVISION - STAGE 5
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP5-8
PAGE: 1 OF 1
JOB NO: NEW15P - 0070A
LOGGED BY: SJK
DATE: 28/7/17

EQUIPMENT TYPE: CASE BACKHOE 580ST
TEST PIT LENGTH: 1.5 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

Drilling and Sampling					Material description and profile information					Field Test		Structure and additional observations
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	
BH	Not Encountered						0.05m FILL: MULCH - grey to brown					FILL - MULCH
						SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, grey, fines of low to medium plasticity, with some fine to medium grained gravel and organics.	M				FILL - TOPSOIL
							0.25m FILL: Sandy CLAY - medium to high plasticity, pale brown to orange, brown to red, pale grey, fine to coarse grained sand, some fine to coarse grained sub-angular gravel.					CONTROLLED FILL
		0.40m		0.5		CH				HP	250	
		U50										
		0.80m					0.80m FILL: Sandy CLAY / Clayey SAND - medium plasticity, pale brown to orange and pale grey, fine to coarse grained sand.	M ~ w_P	VSt			
				1.0		CI				HP	250	
				1.5								
							1.60m Clayey SAND - fine to coarse grained, dark brown to grey, fines of medium plasticity.	M	MD			SLOPE WASH
						SC	1.75m					
						CH	Sandy CLAY - medium to high plasticity, pale brown to orange and grey, fine to coarse grained sand.	M ~ w_P	H	HP	450	RESIDUAL SOIL
							1.90m Hole Terminated at 1.90 m					
				2.0								
				2.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample (Glass jar, sealed and chilled on site)
ASS	Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled)
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

APPENDIX B:

Results of Laboratory Testing

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-4907--S01
Issue No: 1

Shrink Swell Index Report

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:
Project No.: NEW15P-0070A
Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/11/2017

Sample Details

Sample ID:	NEW17W-4907--S01	Client Sample ID:	-
Test Request No.:	-	Sampling Method:	AS1289.1.2.1 cl 6.5
Material:	Sandy CLAY	Date Sampled:	26/10/2017
Source:	On-Site	Date Submitted:	26/10/2017
Specification:	No Specification		
Project Location:	Pitt Street, Teralba		
Sample Location:	TP605 - 0.70 to 1.00m		
Borehole Number:	TP605		
Borehole Depth (m):	0.7 - 1.0		

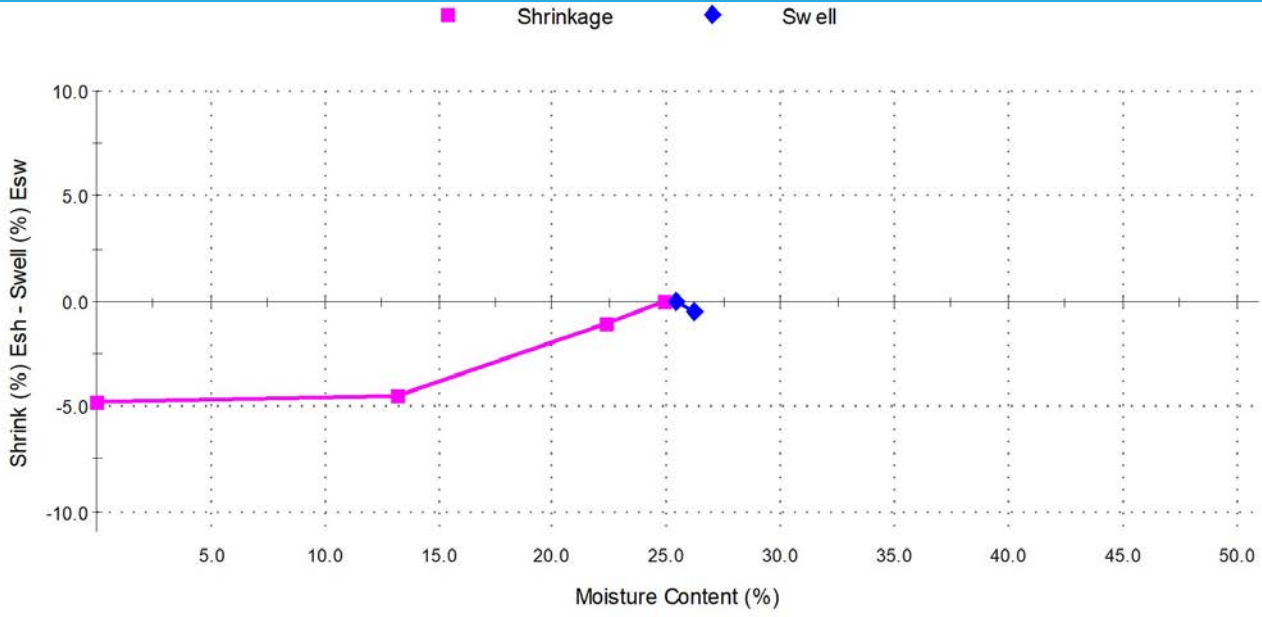
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.5
Moisture Content before (%):	25.4
Moisture Content after (%):	26.2
Est. Unc. Comp. Strength before (kPa):	270
Est. Unc. Comp. Strength after (kPa):	240

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	4.8
Shrinkage Moisture Content (%):	24.9
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 2.7

Comments

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-4907--S02
Issue No: 1

Shrink Swell Index Report

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:
Project No.: NEW15P-0070A
Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/11/2017

Sample Details

Sample ID:	NEW17W-4907--S02	Client Sample ID:	-
Test Request No.:	-	Sampling Method:	AS1289.1.2.1 cl 6.5
Material:	Sandy CLAY	Date Sampled:	26/10/2017
Source:	On-Site	Date Submitted:	26/10/2017
Specification:	No Specification		
Project Location:	Pitt Street, Teralba		
Sample Location:	TP606 - 0.65 to 0.80m		
Borehole Number:	TP606		
Borehole Depth (m):	0.65 - 0.8		

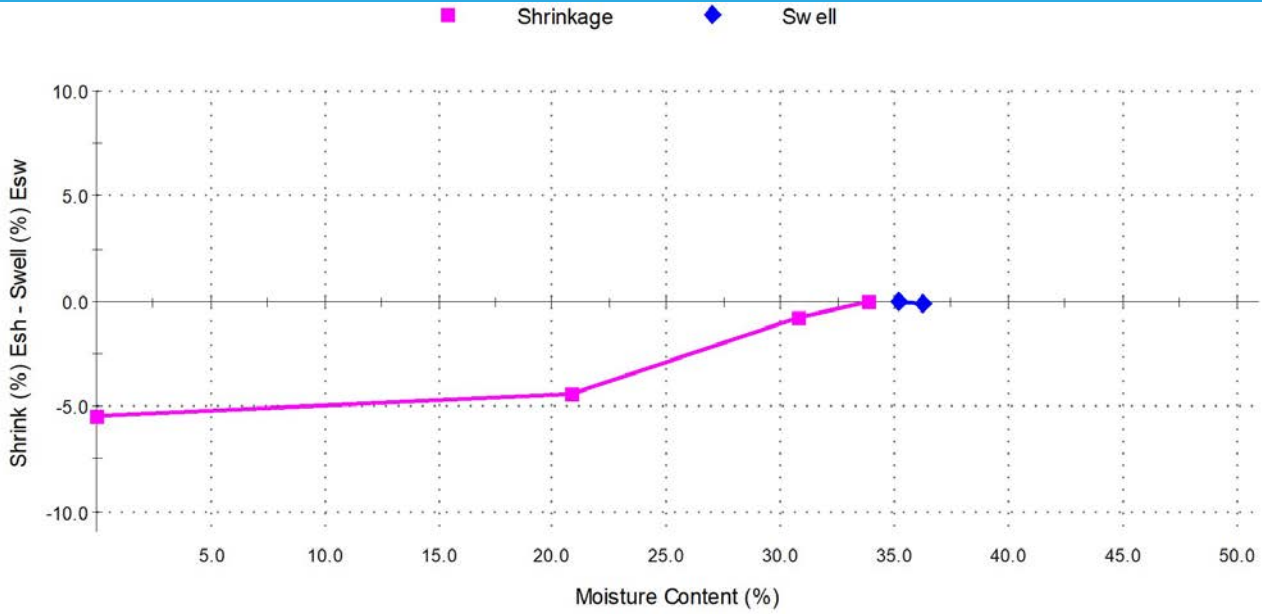
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.2
Moisture Content before (%):	35.2
Moisture Content after (%):	36.2
Est. Unc. Comp. Strength before (kPa):	340
Est. Unc. Comp. Strength after (kPa):	330

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	5.5
Shrinkage Moisture Content (%):	33.9
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 3.0

Comments

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-4907--S03
Issue No: 1

Shrink Swell Index Report

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:
Project No.: NEW15P-0070A
Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/11/2017

Sample Details

Sample ID:	NEW17W-4907--S03	Client Sample ID:	-
Test Request No.:	-	Sampling Method:	AS1289.1.2.1 cl 6.5
Material:	Sandy CLAY	Date Sampled:	26/10/2017
Source:	On-Site	Date Submitted:	26/10/2017
Specification:	No Specification		
Project Location:	Pitt Street, Teralba		
Sample Location:	TP901 - 1.00 to 1.30m		
Borehole Number:	TP901		
Borehole Depth (m):	1.0 - 1.3		

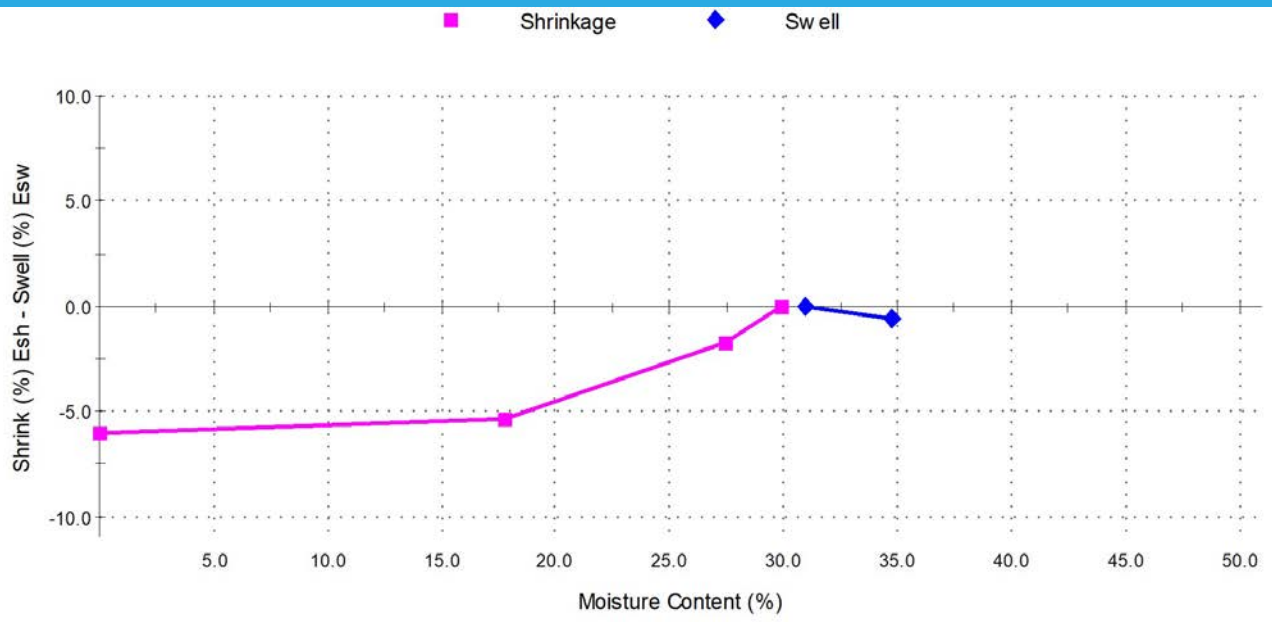
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-0.6
Moisture Content before (%):	30.9
Moisture Content after (%):	34.7
Est. Unc. Comp. Strength before (kPa):	400
Est. Unc. Comp. Strength after (kPa):	370

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	6.0
Shrinkage Moisture Content (%):	29.9
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 3.3

Comments

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: SSI:NEW17W-4907--S04
Issue No: 1

Shrink Swell Index Report

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:
Project No.: NEW15P-0070A
Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 1/11/2017

Sample Details

Sample ID:	NEW17W-4907--S04	Client Sample ID:	-
Test Request No.:	-	Sampling Method:	AS1289.1.2.1 cl 6.5
Material:	Sandy CLAY	Date Sampled:	26/10/2017
Source:	On-Site	Date Submitted:	26/10/2017
Specification:	No Specification		
Project Location:	Pitt Street, Teralba		
Sample Location:	TP902 - 0.80 to 0.95m		
Borehole Number:	TP902		
Borehole Depth (m):	0.8 - 0.95		

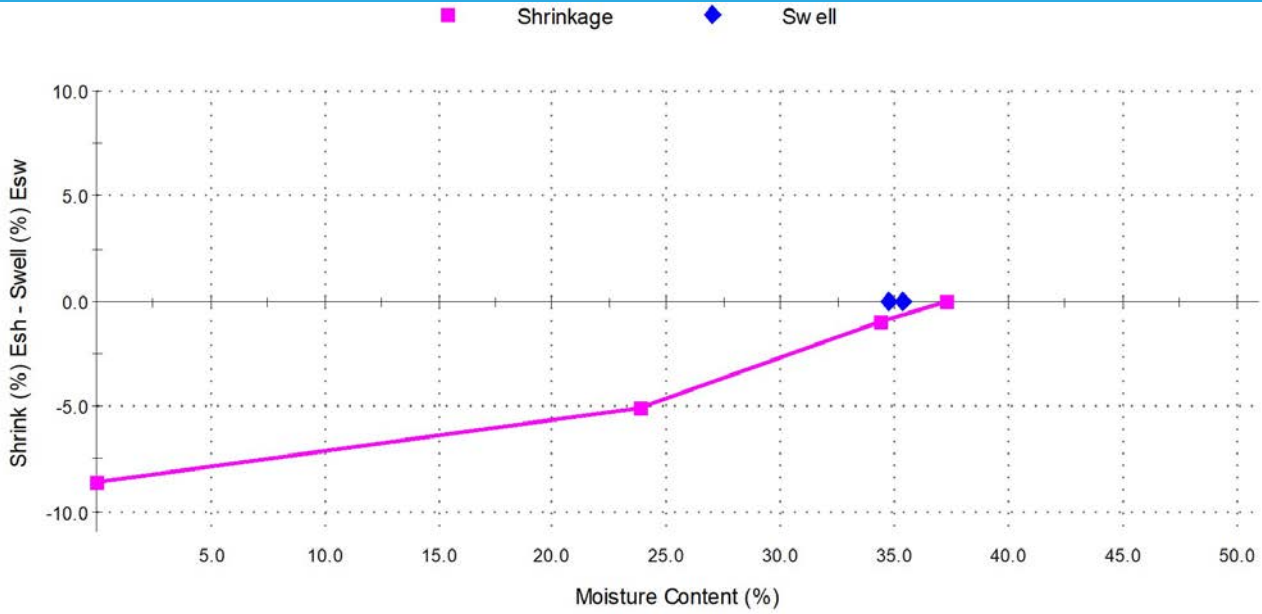
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	0.0
Moisture Content before (%):	34.7
Moisture Content after (%):	35.3
Est. Unc. Comp. Strength before (kPa):	250
Est. Unc. Comp. Strength after (kPa):	90

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	8.6
Shrinkage Moisture Content (%):	37.3
Est. inert material (%):	2%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Major

Shrink Swell



Shrink Swell Index - Iss (%): 4.8

Comments

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S01
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:
Project No.: NEW15P-0070A
Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 9/11/2017

Sample Details

Sample ID:	NEW17W-4926--S01
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Sandy Clay
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP602 - (0.2 - 0.25m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	3.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	27	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	10	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S02
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 9/11/2017

Sample Details

Sample ID:	NEW17W-4926--S02
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Sandy Clay
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP603 - (0.5 - 0.7m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	37	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	20	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S03
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 9/11/2017

Sample Details

Sample ID:	NEW17W-4926--S03
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Sandy Clay
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP604 - (0.7 - 0.9m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	9.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	60	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	43	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S04
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S04
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Sandy Clay
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP901 - (0.1 - 0.2m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	1.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	15	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	3	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S05
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S05
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Clayey Sand
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP903 - (0.1 - 0.2m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	3.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	23	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	8	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Material Test Report

Report No: MAT:NEW17W-4926--S06
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S06
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Clayey Sand
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP904 - (0.2 - 0.3m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	2.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	23	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	5	

Comments

N/A

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E: admin@qualtest.com.au
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Material Test Report

Report No: MAT:NEW17W-4926--S07
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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

Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 9/11/2017

Sample Details

Sample ID:	NEW17W-4926--S07
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Sandstone
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP905 - (0.4 - 0.5m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	9.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	37	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	20	

Comments

N/A

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Material Test Report

Report No: MAT:NEW17W-4926--S08
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S08
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Clayey Sand
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP906 - (0.1 - 0.2m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	13	

Comments

N/A

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Material Test Report

Report No: MAT:NEW17W-4926--S09
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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Approved Signatory: Dane Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S09
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Clayey Sand
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP907 - (0.1 - 0.3m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	2.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	23	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	7	

Comments

N/A

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Material Test Report

Report No: MAT:NEW17W-4926--S10
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 1 Level 3, 426 King Street
Newcastle West NSW 2300

Principal:

Project No.: NEW15P-0070A

Project Name: Proposed Subdivision - Billy's Lookout - Stages 6 & 9

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Approved Signatory: Dane Cullen
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NATA Accredited Laboratory Number: 18686
Date of Issue: 6/11/2017

Sample Details

Sample ID:	NEW17W-4926--S10
Sampling Method:	AS1289.1.2.1 cl 6.4b
Date Sampled:	24/10/2017
Source:	On-Site
Material:	Clayey Sand
Specification:	No Specification
Project Location:	Pitt Street, Teralba
Sample Location:	TP908 - (0.2 - 0.4m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	44	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	26	

Comments

N/A

APPENDIX C:

CSIRO Sheet BTF 18

Foundation Maintenance and Footing Performance: A Homeowner's Guide

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

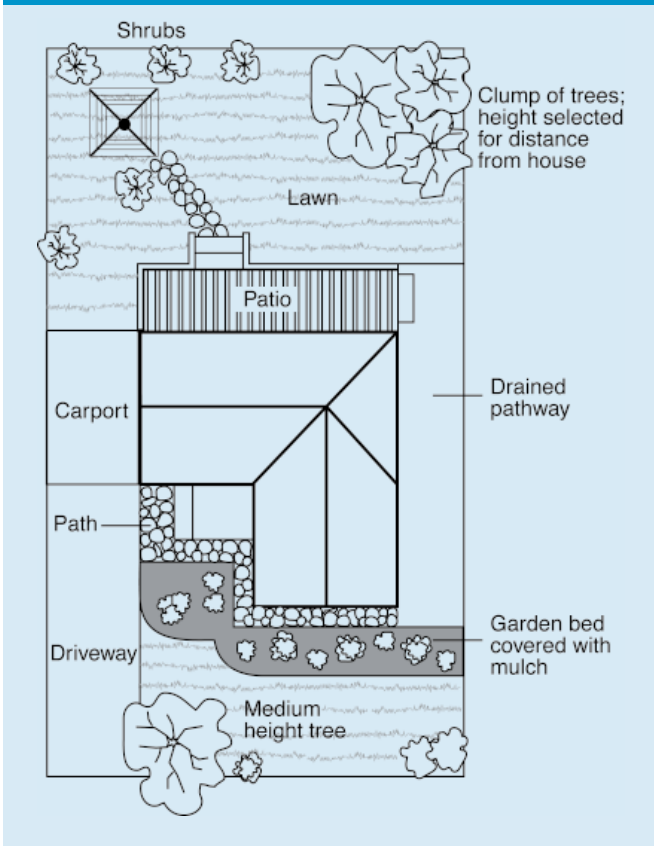
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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