Residential Subdivision Billy's Lookout - Stage 21A Site Classification

Fishermans Drive, Teralba

NEW15P-0070C-AC
5 March 2019

LABORATORY (NSW) PTY LTD

GEOTECHNICAL I LABORATORY I EARTHWORKS I QUARRY I CONSTRUCTION MATERIAL TESTING

5 March 2019

McCloy Development Management Pty Ltd
Suite 2, Ground Floor, 317 Hunter Street
NEWCASTLE NSW 2300

Attention: Harry Thomson

Dear Sir,

RE: PROPOSED SUBDIVISION – BILLY'S LOOKOUT – STAGE 21A
FISHERMANS DRIVE, TERALBA
SITE CLASSIFICATION (PROPOSED SUBDIVISION OF LOT 2131)

Please find enclosed our geotechnical report for Stage 21A of the 'Billy's Lookout' residential subdivision, 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*', for Stage 21A (Lots 1 to 4 within the proposed subdivision of Lot 2131).

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

Table of Contents:

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 Stage 21A of the 'Billy's Lookout' residential subdivision, located at Fishermans Drive, Teralba.

Based on the brief and drawing provided by the client, Stage 21A is understood to comprise of four residential allotments (Lots 1 to 4 within the proposed subdivision of Lot 2131).

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 Stage 21A 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 – Stage 21A, Fishermans Drive, Teralba, (Report Reference: NEW15P-0070C-AA, dated 17 August 2018);
- Level 1 Site Re-grade Assessment Report, 'Proposed Subdivision, Billy's Lookout – Stage 21 & 22, Fishermans Drive, Teralba, (Qualtest Report Reference: NEW18P-0220-AA, dated 18 February 2019); and,
- Site Classification report, 'Proposed Subdivision, Billy's Lookout – Stage 21, Fishermans Drive, Teralba, (Report Reference: NEW15P-0070C-AB, dated 27 February 2019).

This report includes a summary of selected results from the previous reports where applicable.

3.0 Field Work

Field work investigations were initially carried out during previous investigation for Stage 21A on 27 July 2018. Regrading including stripping of topsoil and unsuitable material and filling was carried out following that investigation, as described in Section 4.1. Field work investigations were carried out on Stage 21A lots on 4 and 28 February 2019. Relevant investigations include:

- Excavation of four test pits (TP2101 to TP2104) using an 8 tonne backhoe with a 0.45m wide toothed bucket, to depths of between 0.60m and 1.00m;
- Excavation of two test pits on adjacent lots (TP21B05 and TP21B06) using a 2.7 tonne excavator with a 0.45m wide toothed bucket, to depths of 1.20m;
- Excavation of four hand augered boreholes (BH21B05A to BH21B06A, and BH21B15 to BH21B16) to depths of between 0.30m to 1.00m;
- Undisturbed samples (U50 tubes) were taken for subsequent laboratory testing; and,
- Test pits were backfilled with the excavation spoil and compacted using the excavator bucket and tracks. Boreholes were backfilled with the hand auger.

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

Approximate test pit and borehole locations are shown on the attached Figure AC1. Engineering logs of the test pits are presented in Appendix A.

4.0 Site Description

4.1 Site Regrade Works

Site re-grading works were conducted between 26 October 2018 and 5 November 2018. The re-grading works consisted of the cutting and filling of proposed residential lots within both Stage 21 and Stage 22 of the subdivision. Residential lots within Stage 21A where filling was performed included Lots 1 to 4. These lots are within and area which was described as Lot 838 within Stage 21 at the time of the regrade works.

Prior to filling, re-grade areas were stripped of all topsoil and unsuitable material to expose suitable natural 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 approximate depth of fill placed ranged in the order of 0.1m to about 1.0m. The fill was compacted in maximum lifts of 0.3m thickness. Any unsuitable or deleterious material within the fill was removed by hand or mechanical means prior to final compaction of the material.

As the geotechnical testing authority engaged for the project, Qualtest state that the re-grading works performed within Stage 21A of the development (i.e. the filling of Lots 1 to 4) 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*".

Refer to Qualtest Level 1 Site Re-grade Assessment Report (Ref. NEW18P-0220-AA, dated 18 February 2019) for further details including the approximate limit of filling works for this stage of the project.

The recommendations of this report are based on the understanding that any existing lot re-grade works are limited to the controlled earthworks supervised by Qualtest, placement of the fill material observed to depths of 0.4m or less within test pits, and placement of low reactivity topsoil material such that total depth of topsoil and uncontrolled fill does not exceed 0.4m. Qualtest should be informed without delay if additional earthworks are known to have been carried out.

It is understood that underground services have been installed within an easement near the rear (south-western side) of the lots. This is outside the area of site regrading supervised by Qualtest i.e. Qualtest have not supervised backfilling of service trenches. It is expected that footings for any settlement sensitive developments will be founded outside of or below all zones of influence resulting from the service trenches.

At the time of the field investigations on 5 February 2019, fill stockpiles were present on a number of lots. During a subsequent site visits on 22 and 28 February 2019, the stockpiles were confirmed to mostly have been removed, with some small mounds and temporary mulch stockpiles present.

4.2 Surface Conditions

The site comprises proposed Stage 21A of the Billy's Lookout subdivision, located off Fishermans Drive, Teralba, as shown on Figure AC1 attached.

It is located in a region of gently to moderately undulating topography, on the mid to upper slopes of a broad hill formation.

The site is bounded to the south by a narrow strip of bushland and the Main Northern Railway, and to the north by Fishermans Drive and adjoining stages of the subdivision development.

On the day of the field investigations, the site had been cleared, and partially topsoiled.

The majority of the site was judged to be moderately drained by way of surface runoff following the altered topography towards the east and south, with infiltration and ponded water from recent wet weather causing the near surface soils to become wet and boggy in places.

Trafficability was judged to be good by way of 4WD vehicle along the existing access track at the rear of the lots. Trafficability was limited within some wet areas.

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

Photograph 1: Facing northeast from western corner of site (Lot 1).

Photograph 2: Facing southeast from western corner of site (Lot 1).

Photograph 3: Facing south from northern corner of site (Lot 1).

Photograph 4: Facing northwest from southeast of site.

4.3 Subsurface Conditions

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.

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

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES

Unit	Soil Type	Description
1A	FILL – TOPSOIL & MULCH	Mulch – generally up to about 50mm depth, overlying; Clayey SAND - fine to medium/coarse grained, dark grey-brown, fines of low plasticity, root affected, with some sticks/mulch. Sandy CLAY – low plasticity, dark grey-brown, fine to medium grained sand, with gravel in places, with some sticks and mulch.
1B	FILL – CONTROLLED	Sandy CLAY – medium plasticity, grey and orange-brown to brown, fine to coarse grained sand, with gravel in places. Sandy CLAY / Clayey SAND in places. Gravelly CLAY / Gravelly Sandy CLAY – medium to high plasticity, pale grey to grey with some orange-brown / red-brown, fine to medium grained rounded to sub-angular gravel, with some fine to coarse grained sand. Fill encountered in TP2104 during previous investigation was not controlled but has been stripped and replaced in areas of controlled filling.
2	TOPSOIL	Silty SAND - fine to medium grained, grey-brown, fines of low plasticity, root affected.
3	SLOPEWASH / COLLUVIUM	Clayey SAND - fine to medium grained, pale grey-brown, fines of low plasticity, with some roots.
4	RESIDUAL SOIL	Sandy CLAY / Clayey SAND – low to medium plasticity, grey and pale orange-brown, fine to coarse grained (mostly fine to medium grained) sand. Sandy CLAY, CLAY – medium to high plasticity, pale grey and pale orange-brown, fine to medium/coarse grained sand.
5	EXTREMELY WEATHERED (XW) ROCK	Extremely Weathered Sandstone with soil properties; breaks down into Clayey SAND – fine to coarse grained (mostly fine to medium grained), orange-brown and grey, fines of low plasticity. Extremely Weathered Sandstone with soil properties; breaks down into Sandy GRAVEL – fine to medium grained angular to sub-angular, red-brown to orange-brown, fine to coarse grained sand.
6	HIGHLY WEATHERED (HW) ROCK	SANDSTONE, Silty SANDSTONE - fine to medium grained, grey and orange-brown / red-brown, estimated low to medium strength.

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

TEST PIT NO.	UNIT 1A Fill - Topsoil & Mulch	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 Investigation							
TP21B05	0.00 - 0.70#	-	-	-	0.70 - 1.10	-	1.10 - 1.20*
TP21B06	0.00 - 0.35	0.35 - 1.10	-	-	-	1.10 - 1.20*	-
BH21B05A	0.00 – 0.25	-	-	-	0.25 – 0.30	-	-
BH21B06A	0.00 – 0.10	0.10 – 0.30	-	-	-	-	-
BH21B15	0.00 – 0.25	0.25 – 0.75	-	-	0.75 – 1.00	-	-
BH21B16	0.00 – 0.30	-	-	-	0.30 – 0.80	-	-

Notes:

***** = Practical refusal of 2.7 tonne excavator on Highly Weathered Rock;

^ = Very slow progress (almost practical refusal) of 2.7 tonne excavator on Extremely Weathered to Highly Weathered Rock;

= Topsoil depth greater than 0.40m observed on day of investigation; it is understood that the depth of topsoil on the affected lots was reduced to less than or equal to 0.40m following the field work, as confirmed by profile encountered in BH21B05A.

Earthworks have been carried out on the site following the previous geotechnical investigation at Stage 21A (refer Section 4.1). Therefore, soil profiles have generally changed from those shown at TP2101 to TP2104, i.e. stripping followed by placement of up to about 0.8m of controlled fill plus topsoil.

TEST PIT NO.	**UNIT 1A** **Fill - Topsoil & Mulch**	**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)						
Previous Investigation (NEW15P-0070C-AA, dated 17/08/2018)							
TP2101	0.00 - 0.05	-	0.05 - 0.30	-	0.30 - 0.75	-	0.75 - 0.95**
TP2102	0.00 - 0.05	-	0.05 - 0.35	-	0.35 - 0.55	-	0.55 - 0.60**
TP2103	-	-	0.00 - 0.15	0.15 - 0.45	0.45 - 0.65	0.65 - 0.75	0.75 - 0.80**
TP2104	0.00 - 0.20	0.20 - 0.80	-	-	0.80 - 0.90	0.90 - 0.95	0.95 - 1.00**
Notes:	** = Practical refusal of 8 tonne backhoe on Highly Weathered Rock. Earthworks have been carried out on the site following the previous geotechnical investigation at Stage 21A (refer Section 4.1). Therefore, soil profiles have generally changed from those shown at TP2101 to TP2104, i.e. stripping followed by placement of up to about 0.8m of controlled fill plus topsoil.						

No groundwater was 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.

5.0 Laboratory Testing

Samples collected during the field investigations were returned to our NATA accredited Warabrook Laboratory for testing which comprised of (14 no.) Shrink / Swell tests.

Results of the laboratory testing are included in Appendix B, with a summary of the Shrink/Swell and Atterberg Limits tests presented in Tables 3 and 4.

TABLE 3 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

Location	Depth (m)	Material Description	I_{ss} (%)
TP21B05	0.80 – 0.95	(CI) Sandy CLAY	2.8
TP21B06	0.45 – 0.60	FILL: (CH) Gravelly CLAY	1.8
Previous Investigation (NEW15P-0070C-AA, dated 17/08/2018)			
TP2101	0.40 – 0.65	(CH) CLAY	3.7

TABLE 4 – SUMMARY OF ATTERBERG LIMITS TESTING RESULTS

Location	Depth (m)	Material Description	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
Previous Geotechnical Investigation (Ref. NEW15P-0070C-AA, dated 17/08/2018)						
TP2103	0.50 – 0.60	(CI) Sandy CLAY	44	17	27	10.5

6.0 Site Classification to AS2870-2011

Based on the results of the field work and laboratory testing, residential lots located within Stage 21A of the Billy's Lookout subdivision located at Fishermans Drive, Teralba, as shown on Figure AC1, are classified in their current condition in accordance with AS2870-2011 *'Residential Slabs and Footings'*, as shown in Table 4.

TABLE 4 – SITE CLASSIFICATION TO AS2870-2011

Stage	Lot Numbers	Site Classification
21A	1 to 4	**H1**

A characteristic free surface movement in the range of 40mm to 60mm is estimated for lots classified as **Class 'H1'**.

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. This includes the backfilled trenches for services installed within easements at the rear of lots as shown in Figure AC1;
- 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; and,
- 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 locations. It should be noted that subsurface conditions between and away from the test 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.

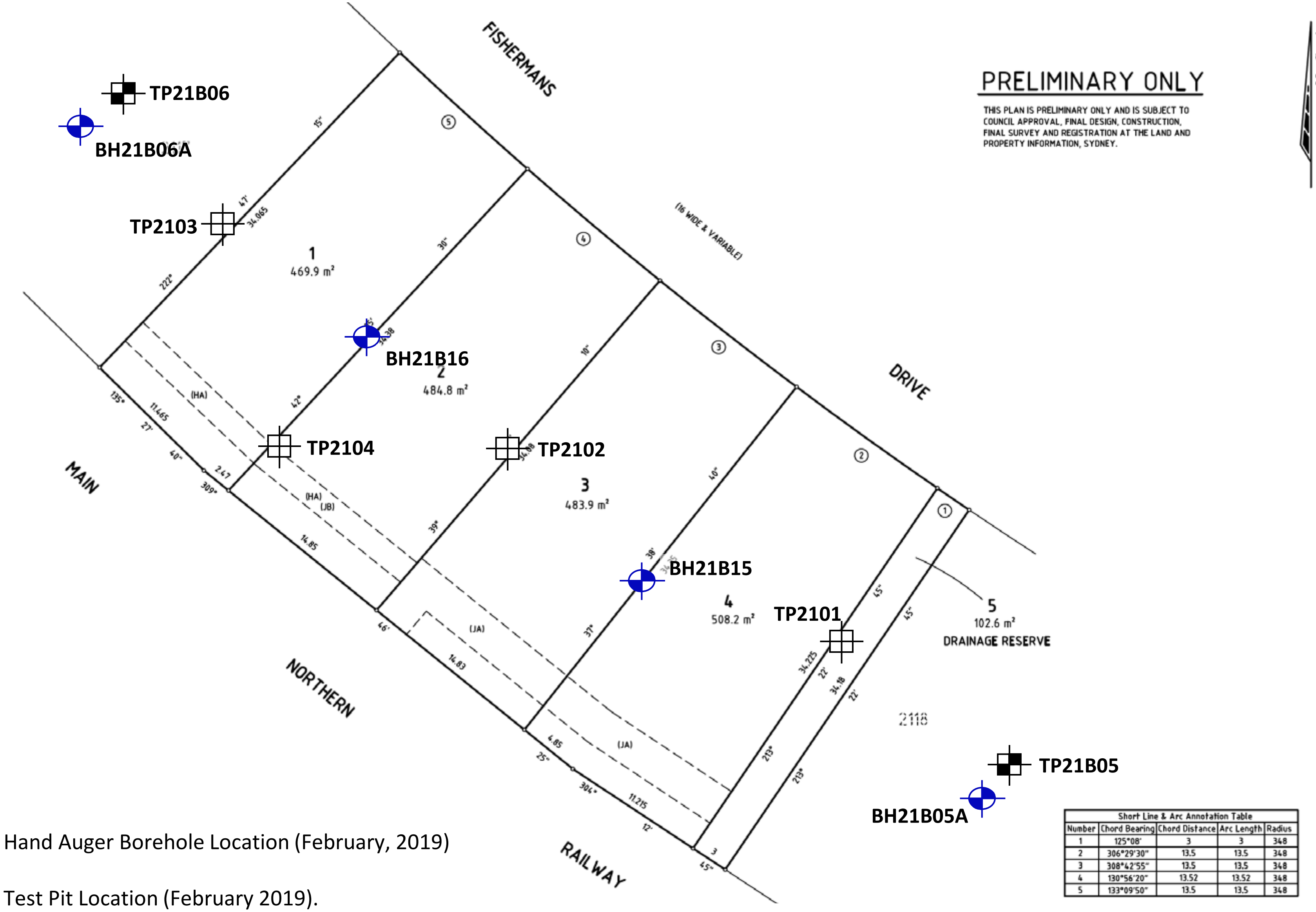
If you have any further questions regarding this report, please do not hesitate to contact Shannon Kelly or the undersigned.

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

Jason Lee
Principal Geotechnical Engineer

FIGURES:

Figure AC1 – Site Plan and Approximate Test Locations



Short Line & Arc Annotation Table				
Number	Chord Bearing	Chord Distance	Arc Length	Radius
1	125°08'	3	3	348
2	306°29'30"	13.5	13.5	348
3	308°42'55"	13.5	13.5	348
4	130°56'20"	13.52	13.52	348
5	133°09'50"	13.5	13.5	348

LEGEND:

Approximate Hand Auger Borehole Location (February, 2019)

Approximate Test Pit Location (February 2019).

Approximate Test Pit Location (NEW15P-0070C-AA, 17/08/2018).

Based on approved subdivision plan by Nigel Delfs (DA/1304/2018, date of approval 24/12/2018)

Qualtest LABORATORY (NSW) PTY LTD

Client:	MCCLOY DEVELOPMENT MANAGEMENT PTY LTD	Drawing No:	FIGURE AC1
Project:	BILLYS LOOKOUT - STAGE 21A	Project No:	NEW17P-0070C
Location:	FISHERMANS DRIVE, TERALBA	Scale:	N.T.S.
Title:	SITE PLAN AND APPROXIMATE TEST LOCATIONS	Date:	27/02/2019

APPENDIX A:

Engineering Logs of Test Pits

ENGINEERING LOG - HAND AUGER

HAND AUGER NO: **BH21B05A**

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	McCLOY GROUP	**PAGE:**	1 OF 1
PROJECT:	BILLYS LOOKOUT - STAGE 21A	**JOB NO:**	NEW15P-0070C
LOCATION:	FISHERMANS DRIVE, TERALBA	**LOGGED BY:**	BB
		DATE:	28/2/19

DRILL TYPE: HAND AUGER

BOREHOLE DIAMETER: 100 mm

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
HA	Not Encountered			0.05m			FILL: MULCH					FILL - TOPSOIL
						CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown (mostly fine to medium grained), trace fine to medium grained sub-angular to sub-rounded gravel, with some sticks.					
				0.25m		CI	Sandy CLAY - medium plasticity, pale orange-brown to orange-brown, fine to medium grained sand.					RESIDUAL SOIL
				0.30m			Hole Terminated at 0.30 m					
				0.5								
				1.0								
				1.5								

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	

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

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%

ENGINEERING LOG - HAND AUGER

HAND AUGER NO: **BH21B06A**

CLIENT:	McCLOY GROUP	**PAGE:**	1 OF 1
PROJECT:	BILLYS LOOKOUT - STAGE 21A	**JOB NO:**	NEW15P-0070C
LOCATION:	FISHERMANS DRIVE, TERALBA	**LOGGED BY:**	BB
		DATE:	28/2/19

DRILL TYPE: HAND AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm **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
HA	Not Encountered					CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, grey-brown, fine to coarse grained sand, trace fine grained angular gravel, with some sticks and mulch.					FILL - TOPSOIL
				0.10m		CH	FILL: Gravelly CLAY - medium to high plasticity, pale grey with some orange-brown and brown, fine to medium grained rounded to sub-angular gravel, with some fine to coarse grained (mostly fine to medium grained) sand.					FILL - CONTROLLED
				0.30m			Hole Terminated at 0.30 m					
				0.5								
				1.0								
				1.5								

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)
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B	Bulk Sample

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DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
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Consistency		**UCS (kPa)**
VS	Very Soft	<25
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VSt	Very Stiff	200 - 400
H	Hard	>400
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VD	Very Dense	Density Index 85 - 100%

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW15P-0070C STAGE 21A LOGS.GPJ <<DrawingFile>> 01/03/2019 09:28 10.0.000 Datgel Lab and In Situ Tool

ENGINEERING LOG - HAND AUGER

HAND AUGER NO: **BH21B15**

CLIENT:	McCLOY GROUP	**PAGE:**	1 OF 1
PROJECT:	BILLYS LOOKOUT - STAGE 21A	**JOB NO:**	NEW15P-0070C
LOCATION:	FISHERMANS DRIVE, TERALBA	**LOGGED BY:**	BB
		DATE:	28/2/19

Qualtest LABORATORY (NSW) PTY LTD

DRILL TYPE: HAND AUGER **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm **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
HA	Not Encountered						FILL: MULCH	M				FILL - TOPSOIL
				0.10m		CL	FILL-TOPSOIL: Gravelly Sandy CLAY - low plasticity, dark grey-brown, fine to coarse grained sand, fine to medium grained angular gravel.	M < W_P				FILL - CONTROLLED
				0.25m		CH	FILL: Sandy CLAY - medium to high plasticity, pale orange-brown, fine to medium grained sand, with some fine to medium grained angular to sub-angular gravel.	M < W_P	VSt			
				0.50m		CL	FILL: Sandy CLAY - low to medium plasticity, grey-brown, fine to coarse grained sand, trace fine to medium grained sub-angular gravel.	M ~ W_P	VSt			
				0.75m		CI	CLAY - medium plasticity, pale orange-brown with some red-brown, with some fine to medium grained sand.	M > W_P	St			RESIDUAL SOIL
				1.00m			Hole Terminated at 1.00 m					

Depth scale: 0.5, 1.0, 1.5

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

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CBR	Bulk sample for CBR testing
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Moisture Condition

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

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%

ENGINEERING LOG - HAND AUGER

Qualtest LABORATORY (NSW) PTY LTD

HAND AUGER NO: **BH21B16**

CLIENT:	McCLOY GROUP	**PAGE:**	1 OF 1
PROJECT:	BILLYS LOOKOUT - STAGE 21A	**JOB NO:**	NEW15P-0070C
LOCATION:	FISHERMANS DRIVE, TERALBA	**LOGGED BY:**	BB
		DATE:	28/2/19

DRILL TYPE: HAND AUGER **SURFACE RL:**
BOREHOLE DIAMETER: 100 mm **DATUM:**

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
HA	Not Encountered			0.05m			FILL: MULCH	M				FILL - TOPSOIL
				0.30m		CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey, fine to medium grained sand.	M < W_P				
				0.5		CH	CLAY - medium to high plasticity, pale grey to white with some pale orange-brown, trace fine grained sand.	M ~ W_P	H			RESIDUAL SOIL
				0.80m			With some fine to medium grained sand, orange and grey-brown, trace fine to medium grained angular to sub-angular gravel.	M > W_P	VSt			
				1.0 / 1.5			Hole Terminated at 0.80 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	

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

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%

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

CLIENT:	McCLOY GROUP	**TEST PIT NO:**	**TP21B05**
PROJECT:	BILLYS LOOKOUT - STAGE 21A	**PAGE:**	1 OF 1
LOCATION:	FISHERMANS DRIVE, TERALBA	**JOB NO:**	NEW15P-0070C
		LOGGED BY:	BB
		DATE:	4/2/19

EQUIPMENT TYPE: 2.7 TONNE EXCAVATOR **SURFACE RL:**
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.5 m **DATUM:**

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			0.00–0.20m		SC	FILL-TOPSOIL: Clayey SAND - fine to coarse grained, dark grey-brown, fines of low plasticity, with some mulch and sticks.					FILL - TOPSOIL
				0.20m–0.70m (0.5)		CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, dark grey-brown (mostly fine to medium grained), trace fine to medium grained sub-angular to sub-rounded gravel, with some sticks.			HP HP HP HP	180 150 160 180	
		0.80m U50 0.95m		0.70m–1.10m (1.0)		CI	Sandy CLAY - medium plasticity, pale orange-brown to orange-brown, fine to medium grained sand.			HP HP HP HP	320 350 360 330	RESIDUAL SOIL
				1.10m–1.20m			Silty SANDSTONE - fine to medium grained, grey and orange-brown, estimated low to medium strength.					HIGHLY WEATHERED ROCK
				1.20m (1.5)			Hole Terminated at 1.20 m Practical Refusal					

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	

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

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%

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

TEST PIT NO: TP21B06
CLIENT: McCLOY GROUP
PAGE: 1 OF 1
PROJECT: BILLYS LOOKOUT - STAGE 21A
JOB NO: NEW15P-0070C
LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BB
DATE: 4/2/19

EQUIPMENT TYPE: 2.7 TONNE EXCAVATOR
SURFACE RL:
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.5 m
DATUM:

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			0.00		CL	FILL-TOPSOIL: Sandy CLAY - low plasticity, grey-brown, fine to coarse grained sand, trace fine grained angular gravel, with some sticks and mulch.					FILL - TOPSOIL
		0.45m U50 0.60m		0.35m		CH	FILL: Gravelly CLAY - medium to high plasticity, pale grey with some orange-brown and brown, fine to medium grained rounded to sub-angular gravel, with some fine to coarse grained (mostly fine to medium grained) sand.			HP HP HP	>600 >600 >600	FILL - CONTROLLED
				0.65m		CI	FILL: Sandy CLAY - medium plasticity, pale brown to brown, fine to medium grained sand.			HP HP	>600 >600	
				1.10m		GP	Extremely Weathered Sandstone with soil properties; breaks down into Sandy GRAVEL - fine to medium grained angular to sub-angular, red-brown to orange-brown and pale grey to grey, fine to coarse grained sand.					EXTREMELY WEATHERED ROCK
				1.20m			Hole Terminated at 1.20 m Practical Refusal					

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	

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

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%

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

TEST PIT NO: TP2101

CLIENT: McCLOY GROUP
PAGE: 1 OF 1

PROJECT: BILLYS LOOKOUT - STAGE 21A
JOB NO: NEW15P-0070C

LOCATION: FISHERMANS DRIVE, TERALBA
LOGGED BY: BB

DATE: 27/7/18

EQUIPMENT TYPE: BACKHOE
SURFACE RL:

TEST PIT LENGTH: 2.0 m **WIDTH:** 0.5 m
DATUM:

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					SM	TOPSOIL: Silty SAND - fine to medium grained, grey-brown, fines of low plasticity, root affected. Top 50mm of mulch.	M				TOPSOIL
		0.40m U50 0.65m		0.30m – 0.5		CH	Sandy CLAY - medium to high plasticity, pale grey and pale brown, fine to medium grained sand.	$M \sim W_p$	VSt - H	HP HP HP HP	350 420 430 380	RESIDUAL SOIL
				0.75m			SANDSTONE - fine to medium grained, red-brown to orange-brown and grey, estimated low to medium strength.	D				HIGHLY WEATHERED ROCK
				0.95m – 1.0			Hole Terminated at 0.95 m Practical Refusal					
				1.5								

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	

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

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%

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

CLIENT: McCLOY GROUP
PROJECT: BILLYS LOOKOUT - STAGE 21A
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP2102
PAGE: 1 OF 1
JOB NO: NEW15P-0070C
LOGGED BY: BB
DATE: 27/7/18

EQUIPMENT TYPE: BACKHOE
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	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				SM	TOPSOIL: Silty SAND - fine to medium grained, dark grey-brown to grey-brown, fines of low plasticity, root affected. Top 50mm of mulch.	M				TOPSOIL
		0.40m U50 0.50m		0.35m	CH	CLAY - medium to high plasticity, pale brown, with some fine to medium grained sand.	M > W_P	VSt	HP HP	230 260	RESIDUAL SOIL
				0.50m – 0.55m	CI	Sandy CLAY - medium plasticity, pale grey, fine to medium grained sand.					
				0.60m		Silty SANDSTONE - fine to medium grained, pale grey-brown with some orange-brown, estimated medium strength.	D				HIGHLY WEATHERED ROCK
						Hole Terminated at 0.60 m Practical Refusal					

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	

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

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%

QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW15P-0070C STAGE 21A LOGS.GPJ <<DrawingFile>> 01/03/2019 09:28 10.0.000 Datgel Lab and In Situ Tool

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

CLIENT: McCLOY GROUP
PROJECT: BILLYS LOOKOUT - STAGE 21A
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP2103
PAGE: 1 OF 1
JOB NO: NEW15P-0070C
LOGGED BY: BB
DATE: 27/7/18

EQUIPMENT TYPE: BACKHOE
TEST PIT LENGTH: 2.0 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					SM	TOPSOIL: Silty SAND - fine to medium grained, dark grey-brown, fines of low plasticity, root affected.	M				TOPSOIL
						SC	0.15m Clayey SAND - fine to medium grained, pale grey-brown, fines of low plasticity, with some roots.					SLOPE WASH
		0.50m U50 0.60m		0.5		CI	0.45m Sandy CLAY - medium plasticity, pale brown and grey, fine to medium grained sand.	M > W_p	VSt	HP HP	220 230	RESIDUAL SOIL
						SC	0.65m Extremely Weathered Sandstone with soil properties; breaks down into Clayey SAND - fine to medium grained, orange-brown and pale grey, fines of low to medium plasticity.	M	VD			EXTREMELY WEATHERED ROCK
							0.75m 0.80m SANDSTONE - fine to medium grained, orange-brown and pale grey, estimated medium strength.	D				HIGHLY WEATHERED ROCK
				1.0			Hole Terminated at 0.80 m Practical Refusal					
				1.5								

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	

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

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%

ENGINEERING LOG - TEST PIT

Qualtest LABORATORY (NSW) PTY LTD

CLIENT: McCLOY GROUP
PROJECT: BILLYS LOOKOUT - STAGE 21A
LOCATION: FISHERMANS DRIVE, TERALBA

TEST PIT NO: TP2104
PAGE: 1 OF 1
JOB NO: NEW15P-0070C
LOGGED BY: BB
DATE: 27/7/18

EQUIPMENT TYPE: BACKHOE
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.5 m
SURFACE RL:
DATUM:

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			0.00–0.20m		SC	FILL-TOPSOIL: Clayey SAND - fine to medium grained, dark grey-brown, fines of low to medium plasticity, with some sticks.	M - W				FILL - TOPSOIL
				0.20–0.80m		CI	FILL: Sandy CLAY - medium plasticity, brown and grey-brown, fine to coarse grained sand, trace cobbles and sticks.	M > W_P	F - St	HP HP HP	130 80 100	FILL
				0.80–0.90m		CI	Sandy CLAY - medium plasticity, pale brown and pale grey, fine to medium grained sand.		VSt	HP	200	RESIDUAL SOIL
				0.90–0.95m		SC	Extremely Weathered Sandstone with soil properties; breaks down into Clayey SAND - fine to medium grained, orange-brown and grey, fines of medium plasticity.	M	VD			EXTREMELY WEATHERED ROCK
				0.95–1.00m			SANDSTONE - fine to medium grained, orange-brown and grey, estimated low to medium strength.	D				HIGHLY WEATHERED ROCK
				1.00m			Hole Terminated at 1.00 m Practical Refusal					

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	

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

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%

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

Shrink Swell Index Report

Report No: SSI:NEW19W-0296--S06
Issue No: 1

Client:	McCloy Development Management Pty Ltd Suite 2, Ground Floor, 317 Hunter Street Newcastle NSW 2300
Principal:	
Project No.:	NEW15P-0070C
Project Name:	Billy's Lookout - Stage 21A

NATA WORLD RECOGNISED ACCREDITATION

Approved Signatory: Adam Dwyer
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 20/02/2019

Sample Details

Sample ID:	NEW19W-0296--S06	**Client Sample ID:**	-
Test Request No.:	-	**Sampling Method:**	AS1289.1.2.1 cl 6.5
Material:	Sandy CLAY	**Date Sampled:**	5/02/2019
Source:	On-SIte	**Date Submitted:**	6/02/2019
Specification:	No Specification		
Project Location:	Teralba, NSW		
Sample Location:	TP21B05 - 0.80 to 0.95m		
Borehole Number:	TP21B05		
Borehole Depth (m):	0.80 to 0.95		

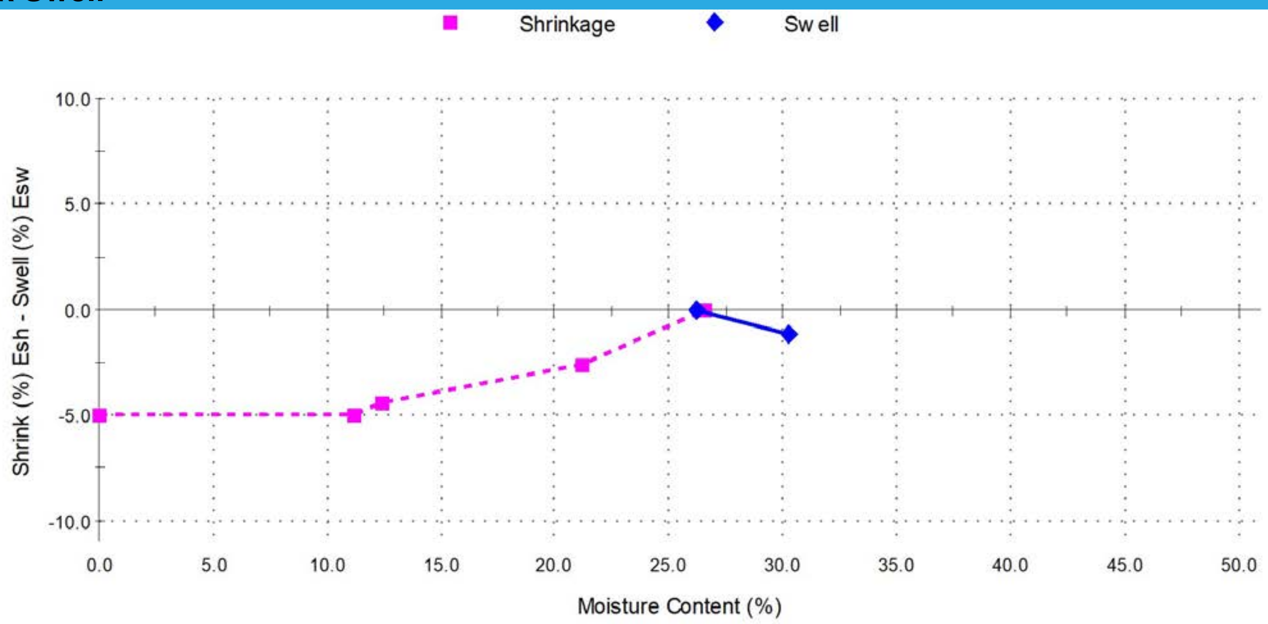
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-1.1
Moisture Content before (%):	26.2
Moisture Content after (%):	30.3
Est. Unc. Comp. Strength before (kPa):	320
Est. Unc. Comp. Strength after (kPa):	150

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	5.0
Shrinkage Moisture Content (%):	26.6
Est. inert material (%):	5.0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 2.8

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

Shrink Swell Index Report

Report No: SSI:NEW19W-0296--S07
Issue No: 1

Client: McCloy Development Management Pty Ltd
Suite 2, Ground Floor, 317 Hunter Street
Newcastle NSW 2300

Principal:
Project No.: NEW15P-0070C
Project Name: Billy's Lookout - Stage 21A

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.
Results provided relate only to the items tested or sampled.
This report shall not be reproduced except in full.

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Adam Dwyer
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 20/02/2019

Sample Details

Sample ID:	NEW19W-0296--S07	**Client Sample ID:**	-
Test Request No.:	-	**Sampling Method:**	AS1289.1.2.1 cl 6.5
Material:	Gravelly CLAY	**Date Sampled:**	5/02/2019
Source:	On-SIte	**Date Submitted:**	6/02/2019
Specification:	No Specification		
Project Location:	Teralba, NSW		
Sample Location:	TP21B06 - 0.45 to 0.60m		
Borehole Number:	TP21B06		
Borehole Depth (m):	0.45 to 0.60		

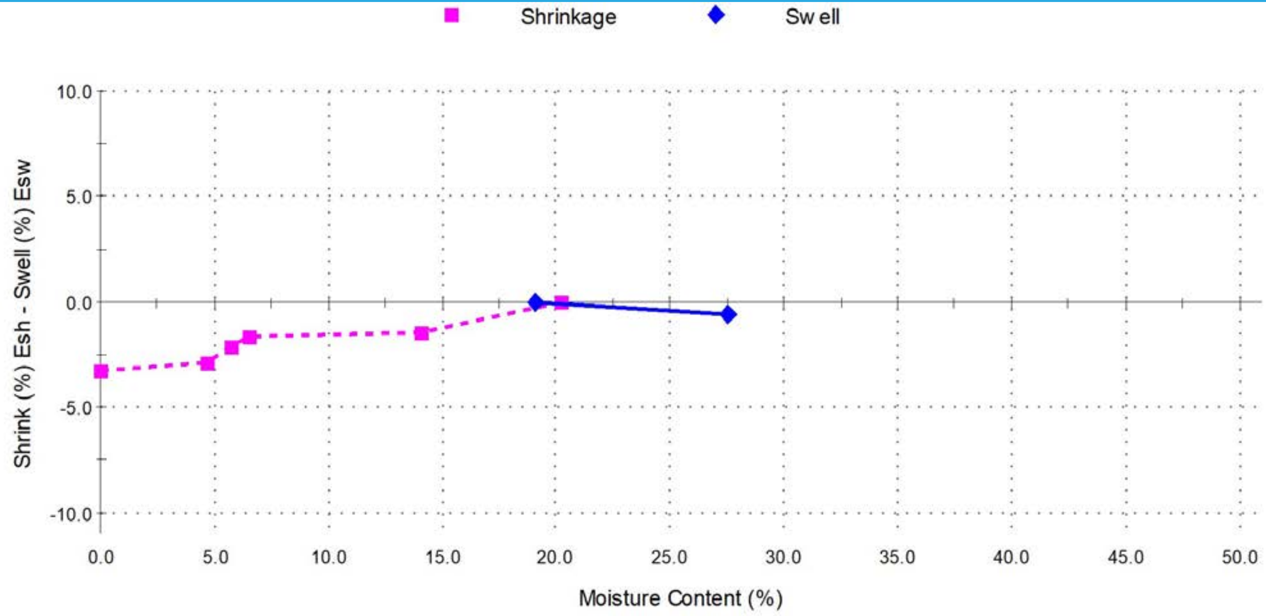
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	-0.6
Moisture Content before (%):	19.1
Moisture Content after (%):	27.5
Est. Unc. Comp. Strength before (kPa):	> 600
Est. Unc. Comp. Strength after (kPa):	280

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	3.3
Shrinkage Moisture Content (%):	20.2
Est. inert material (%):	5.0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Moderate

Shrink Swell



Shrink Swell Index - Iss (%): 1.8

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

Report No: SSI:NEW18W-2490--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-0070C
Project Name:	Billy's Lookout - Stage 21

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: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 8/08/2018

Sample Details

Sample ID:	NEW18W-2490--S01	**Client Sample ID:**	-
Test Request No.:	-	**Sampling Method:**	AS1289.1.2.1 cl 6.5
Material:	Clay	**Date Sampled:**	27/07/2018
Source:	On-Site	**Date Submitted:**	1/08/2018
Specification:	No Specification		
Project Location:	Teralba, NSW		
Sample Location:	TP2101 - (0.4 - 0.65m)		
Borehole Number:	TP2101		
Borehole Depth (m):	0.4 - 0.65		

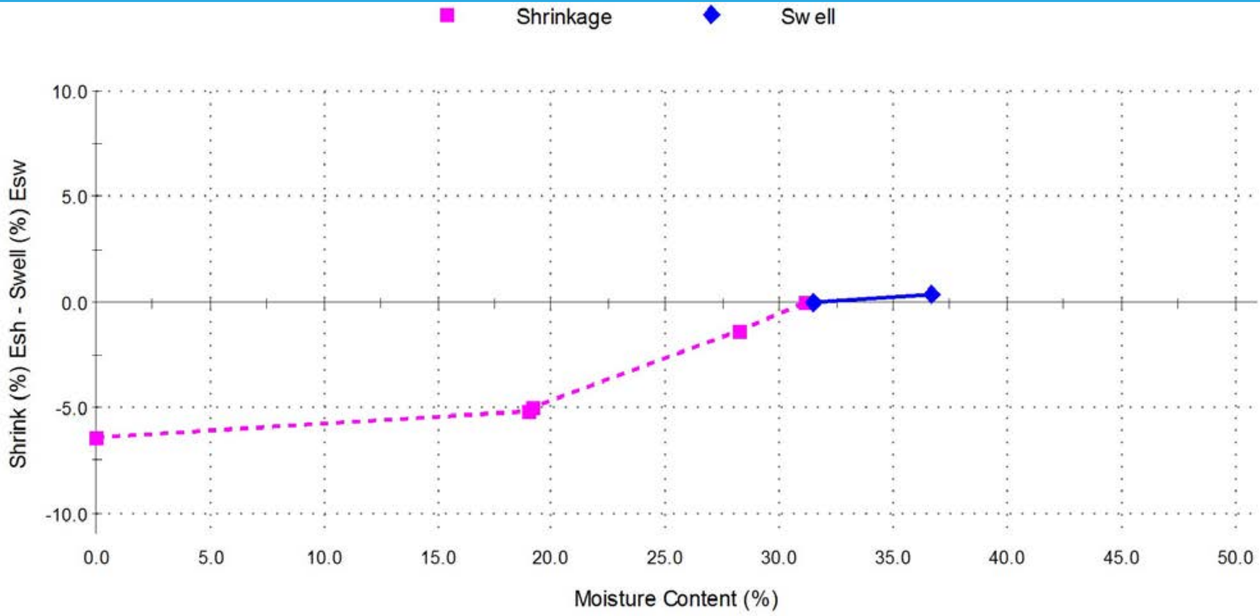
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	0.4
Moisture Content before (%):	31.5
Moisture Content after (%):	36.7
Est. Unc. Comp. Strength before (kPa):	>600
Est. Unc. Comp. Strength after (kPa):	280

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	6.4
Shrinkage Moisture Content (%):	31.1
Est. inert material (%):	5%
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Minor

Shrink Swell



Shrink Swell Index - Iss (%): 3.7

Comments

QUALTEST Laboratory (NSW) Pty Ltd (20708)
8 Ironbark Close Warabrook NSW 2304
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E: admin@qualtest.com.au
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ABN: 98 153 268 896

Report No: MAT:NEW18W-2490--S02
Issue No: 1

Material Test Report

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

Principal:
Project No.: NEW15P-0070C
Project Name: Billy's Lookout - Stage 21

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

B. Cullen

Approved Signatory: Brent Cullen
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 9/08/2018

Sample Details

Sample ID: NEW18W-2490--S02
Client Sample ID: -
Sampling Method: AS1289.1.2.1 cl 6.5
Date Sampled: 27/07/2018
Source: On-Site
Material: Clay
Specification: No Specification
Project Location: Teralba, NSW
TRN -
Sample Location: TP2103 - (0.5 - 0.6m)

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	10.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	44	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	27	

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

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).

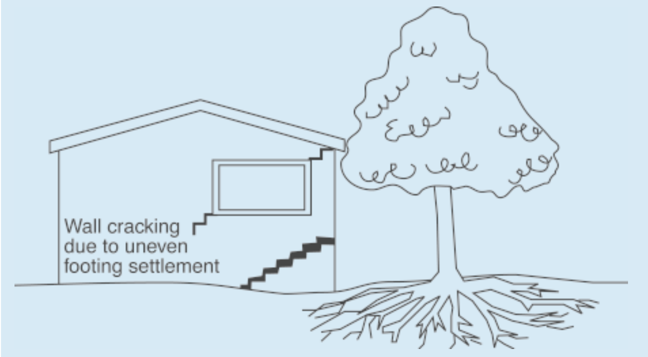
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

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.

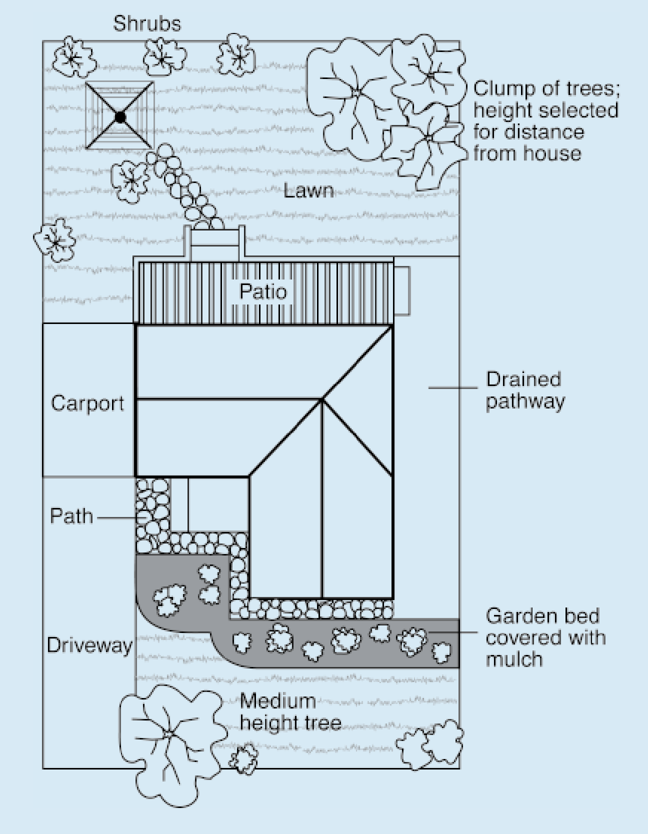
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

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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