Proposed Expansion of Cessnock Correctional Centre Geotechnical Assessment

Lindsay Street, Cessnock

NEW16P-0119-AD 12 September 2016



12 September 2016

Lend Lease L14, International Towers Exchange Place, 300 Barangaroo Ave BARANGAROO NSW 2000

Attention: Mr Jeremy Tompson

Dear Sir

RE: PROPOSED EXPANSION OF CESSNOCK CORRECTIONAL CENTRE LINDSAY STREET, CESSNOCK

GEOTECHNICAL ASSESSMENT

Please find enclosed our Geotechnical Assessment report for the proposed expansion of Cessnock Correctional Centre.

The report includes recommendations for foundation design parameters, Site Classification in accordance with AS2870-2011, "Residential Slabs and Footings", pavement design and construction, site earthworks, and assessment of depth to rock and excavation conditions.

Qualtest previously provided a draft geotechnical report (Ref: NEW16P-0119-AA.Draft, dated 26 August 2016) based on a concept site layout which has been since been revised. This report contains results of additional investigations requested by Lend Lease, based upon the proposed relocation of the subject site from the location identified in the draft geotechnical report (comprising rotation of the proposed development by about 90 degrees clockwise and shifting of the proposed footprint to the east).

This report supersedes the draft geotechnical report (Ref: NEW16P-0119-AA.Draft, dated 26 August 2016).

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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Figure AD1: Approximate Test Locations

Figure AD2: Approximate Test Locations with Concept Overlay

Figure AD3: Excavatability Graph

Appendix A: Results of Field Investigations

Appendix B: Results of Laboratory Testing

Appendix C: CSIRO Sheet BTF 18

1.0 Introduction

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this report to Lend Lease for the proposed expansion of Cessnock Correctional Centre.

This report supersedes the draft geotechnical report (Ref: NEW16P-0119-AA.Draft, dated 26 August 2016) which was based on a concept site layout which has been revised.

Based on the brief provided (email from Lend Lease dated 26 July 2016), subsequent telephone discussions, and a revised concept site layout provided by Lend Lease in an email dated 25 August 2015, the proposed development is understood to comprise a '400 bed proposed maximum' together with new administration buildings, parking and roads adjacent to the east, covering a total plan area about 400m by 300m. It is also understood that site earthworks are likely to involve cut and fill of depths up to about 5m to create a level platform in the area of the proposed 400 bed facility.

The scope of work for the geotechnical investigation included providing discussion and recommendations on the following:

- Site preparation;
- Excavation conditions and depth to rock (where encountered);
- The suitability of the site soils for use as fill and fill construction procedures;
- Foundation design parameters, including recommended bearing pressures and anticipated settlements (for both shallow footings and pier/pile footings);
- Site classification in accordance with AS2870;
- Pavement design and construction;
- Special requirements for construction procedures and or site drainage.

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

2.0 Field Work

Field work investigations were carried out on 4, 9, 10 and 25 August, and 2 September 2016, and comprised of:

- DBYD search and scanning of proposed test locations using an accredited professional cable locator was undertaken to clear proposed test locations for the presence of underground services;
- Site walkover to make observations of surface features at the property and in the immediate surrounding area;
- Drilling of two boreholes (BH01 and BH02) using a truck mounted drilling rig. Borehole BH01
 was drilled into weathered rock to a depth of 2.80m using a TC-bit, then cored by NMLC
 coring techniques to a depth of 8.80m. Borehole BH02 was drilled into weathered rock to a
 depth of 2.40m using a TC-bit, then cored by NMLC coring techniques to a depth of 8.05m;
- Excavation of 26 test pits (TP01 to TP26) using a 14 tonne tracked excavator equipped with a 700mm wide smooth bladed bucket, to depths of between 0.80m and 2.60m within the proposed development area;

- Excavation of 6 test pits (TP27 to TP31 and TP33) using a 5 tonne tracked excavator equipped with a 450mm wide toothed bucket, to depths of between 1.15m and 2.15m at additional locations nominated by the client within the revised development area, to the east of the originally proposed development area;
- Drilling of three boreholes (BH03 to BH05) using a 4WD mounted drilling rig. Borehole BH03 was drilled into weathered rock to a depth of 3.20m using a TC-bit, then cored by NMLC coring techniques to a depth of 6.05m. Borehole BH04 was drilled into weathered rock to a depth of 2.00m using a TC-bit, then cored by NMLC coring techniques to a depth of 5.63m. Borehole BH05 was drilled into weathered rock to a depth of 4.25m using a TC-bit, then cored by NMLC coring techniques to a depth of 5.60m;
- Undisturbed samples (U50 tubes), small bag samples and bulk disturbed samples 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 Senior Geotechnical Engineer and Geotechnical Engineer from Qualtest who located the test pits and boreholes, carried out the sampling and testing, and provided field logs.

Approximate test pit and borehole locations are shown on the attached Figures AD1 and AD2. Test pits and boreholes were located in the field by handheld GPS and relative to existing site features including topographic features, lot boundaries, existing developments and trees.

Engineering logs of the test pits and boreholes are presented in Appendix A.

3.0 Site Description

3.1 Surface Conditions

The subject site is located to the south west of the existing Cessnock Correctional Centre facility off Lindsay Street, Cessnock, NSW, as shown in Figure AD1 and AD2. The subject site is an irregular shaped parcel of land with a plan area of approximately 15 hectares (ha), comprising part of Lot 2 DP76202 and part of Lot 3 DP76202.

The subject site is bounded by the grounds of Cessnock Correctional Centre, generally comprising grounds used for storage of demountable buildings and maintenance facilities to the north and east, and mostly cleared grounds with scattered trees to the south and west. Residential properties and a golf course are located nearby to the south, and a relatively large dam is located on Oaky creek nearby to the west.

Reference to the NSW Land and Property Information Spatial Information Exchange website indicated the elevation of the site ranged from approximately 100m AHD in the eastern portion of the site to 90m AHD in the western portion of the site.

The subject site is positioned on the mid slopes to crest of a gently sloping hill, with a ridge trending in a north-northeast direction roughly bisecting the site. Site surface slopes are generally in the order of about 2° to 4°. The site generally slopes towards the southeast on the eastern side of the ridge. The portion of the site to the west of the ridge slopes towards the southwest in the northern area, and towards the northwest in the southern area.

Surface water would be expected to infiltrate into site soils, with excess surface water draining to the west towards Oaky Creek, and towards the southeast including towards an unnamed dam located outside the south-eastern corner of the site.

The western side of the site is mostly vegetated by maintained grass lands with scattered mature trees and shrubs, with areas of medium dense tree coverage on the south-western area of the site, generally as visible on Figure AD1. A number of demountable buildings are present in the eastern side of the site. Some of the rows of demountable buildings have been subject to shallow cut/fill to make platforms more level. Gravel access roads were observed in the vicinity of the demountable buildings.

A number of fill mounds/stockpiles are present on the site, with approximate extents shown on Figure AD1. Most of the mounds are of depths in the order of 0.5m to 1.5m, with a deeper berm on the southern part of the site.

Photographs of the site taken on the day of the site investigations are shown below.



Photograph 1: From southwest area of the subject site facing west.



Photograph 2: From fill mound near the middle of southern edge of subject site facing northwest.



Photograph 3: From fill mound near the middle of southern edge facing northeast.



Photograph 4: From fill mound near the middle of southern edge facing east.



Photograph 5: From west of the subject site facing northeast.



Photograph 6: From west of the subject site facing east.



Photograph 7 From northwest of the subject site facing southeast.



Photograph 8: From near TP31 facing east.



Photograph 9: From near BH03 facing northeast.



Photograph 10: From near northeast corner of site facing southeast.



Photograph 11: From near northeast corner of site facing southwest.



Photograph 12: From near northeast corner of site facing west.



Photograph 13: From east of site near TP33 facing southwest.



Photograph 14: From east of site facing west. TP33 in background.



Photograph 15: From south-eastern corner of site facing west.



Photograph 16: From south-eastern corner of site facing northwest.

3.2 Subsurface Conditions

Reference to the 1:100,000 Newcastle Coalfield Regional Geology Series Sheet 9231 indicates the site to be underlain by Farley Formation of the Dalwood Group which is characterised by sandstone and siltstone rock types.

Table 1 presents a summary of the typical soil types encountered at test pit and borehole locations during the field investigation, divided into representative geotechnical units.

No water inflows or groundwater levels were encountered in the test pits during the limited time that they remained open on the days of the field investigations. The addition of water to the boreholes for drilling meant that groundwater levels could not be measured during the limited time that the boreholes remained open on the day of the field investigations.

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
1	FILL	Variable materials at different test pit locations including Sandy CLAY and Sandy Clayey GRAVEL – medium to high plasticity, dark grey-brown, fine to medium grained gravel in places, fine to medium grained sand, root affected in places.
2	TOPSOIL	Clayey SAND - low plasticity, dark grey-brown, fine to medium grained sand, trace fine to coarse grained gravel, sub-angular, trace silt, root affected.
3	SLOPEWASH	Clayey SAND and Silty SAND / Sandy SILT – fine to medium grained, dark brown to grey-brown, fines of low plasticity, trace silt, trace rootlets in places. SAND – fine to medium grained, grey-brown, trace silt.
4	residual soil	CLAY / Sandy CLAY / Clayey SAND – mostly medium and medium to high plasticity, varying colour combinations of orange-brown with some grey / dark grey and/or red-brown, fine grained sand. Mostly very stiff to hard consistency.
5	EXTREMELY WEATHERED (XW) ROCK (with soil properties)	Extremely weathered SANDSTONE with soil properties, breaks down into Gravelly Clayey SAND / Clayey SAND – fine grained, mostly grey with some orange, fine to medium grained gravel in places. Assessed to generally be of extremely low to low rock strength.
6	HIGHLY WEATHERED (HW) to FRESH (FR) ROCK	SANDSTONE / PEBBLY SANDSTONE – fine to medium / fine to coarse grained, varying in colour combinations of dark greyblack, orange-brown to brown and grey, estimated strength ranging from very low to high. Generally fractured or semifractured. Generally highly weathered upper rock, becoming moderately
		weathered to fresh rock at depth in boreholes. Extremely to highly weathered and/or extremely weathered layers in places.

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

Very slow progress at close to practical refusal, or practical refusal on rock of the excavator was encountered as indicated in Table 2 and shown on the appended engineering logs.

TABLE 2 – SUMMARY OF GEOTECHNICAL UNITS ENCOUNTERED AT EACH TEST LOCATION

Location	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6		
	Fill	Topsoil	Slopewash	Residual Soil	Extremely Weathered Rock	HW to FR Rock		
			Depth in r	metres (m)				
Boreholes	Boreholes							
BH01	-	-	0.00 - 0.10	0.10 - 1.00	1.00 - 3.04	3.04 - 8.90		
BH02	-	0.00 - 0.05	-	0.05 - 1.50	1.50 - 2.53	2.53 - 8.05		
BH03	0.00 - 0.30	-	-	0.30 - 2.90	2.90 - 3.20	3.20 - 6.05		
BH04	-	0.00 - 0.10	-	0.10 - 1.00	1.00 - 2.00	2.00 - 5.63		
BH05	-	0.00 - 0.15	-	0.15 - 2.80	2.80 - 4.25	4.25 - 5.60		
Test Pits								
TP01	0.00 - 0.45	-	-	0.45 - 1.15	1.15 - 1.20*	-		
TP02	-	0.00 - 0.25	-	0.25 - 1.85	-	1.85 - 1.90*		
TP03	-	0.00 - 0.15	-	0.15 - 1.80	1.80 - 2.40 ^	-		
TP04	-	0.00 - 0.20	-	0.20 - 1.80	1.80 - 2.40 ^	-		
TP05	-	-	0.00 - 0.55	0.55 - 1.80 ^		-		
TP06	0.00 - 0.15	-	-	0.15 - 1.80	1.80 - 2.60^	-		
TP07	-	-	0.00 - 0.55	0.55 - 2.05		2.05 - 2.10*		
TP08	0.00 - 0.20	-	0.20 - 0.60	0.60 - 1.80	1.80 - 2.00^	-		
TP09	-	0.00 - 0.20	-	0.20 - 2.30^	-	-		
TP10	-	0.00 - 0.20	-	0.20 - 2.40 ^	-	-		
TP11	-	0.00 - 0.15	-	0.15 - 2.30^	-	-		
TP12	-	0.00 - 0.15	-	0.15 - 1.60^	-	-		
TP13	-	0.00 - 0.20	-	0.20 - 0.80	0.80 - 0.90*	-		
TP14	-	0.00 – 0.24	-	0.24 - 1.00	1.00 - 1.05*	-		
TP15	-	0.00 - 0.25	-	0.25 - 2.10 ^	-	-		
TP16	-	0.00 - 0.30	-	0.30 - 2.00^	-	-		

Location	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
	Fill	Topsoil	Slopewash	Residual Soil	Extremely Weathered Rock	HW to FR Rock
			Depth in r	metres (m)		
TP17	-	0.00 - 0.20	-	0.20 - 1.00	1.00 - 1.40^	-
TP18	-	0.00 - 0.10	-	0.10 - 1.70	1.70 - 1.80^	-
TP19	-	0.00 - 0.10	-	0.10 - 0.90	0.90 - 1.00*	-
TP20	-	0.00 - 0.25	-	0.25 - 1.45	-	1.45 - 1.50*
TP21	-	0.00 - 0.24	-	0.24 - 1.80 ^	-	-
TP22	-	0.00 - 0.08	-	0.08 - 0.80	-	0.80 - 0.85*
TP23	-	0.00 - 0.14	-	0.14 - 0.75	-	0.75 - 0.80*
TP24	-	0.00 - 0.28	-	0.28 - 1.40	1.40 - 1.50*	-
TP25	-	0.00 - 0.20	-	0.20 - 1.00	-	1.00 - 1.10*
TP26	-	0.00 - 0.10	0.10 - 0.30	0.30 - 1.75	-	1.75 - 1.80*
TP27	-	0.00 - 0.10	-	0.10 - 0.90	0.90 - 1.30	1.30 - 1.40*
TP28	-	0.00 - 0.15	-	0.15 - 2.10	-	2.10 - 2.15*
TP29	-	0.00 - 0.10	0.10 - 0.20	0.20 - 1.40	-	1.40 - 1.50*
TP30	0.00 - 0.10	-	0.10 - 0.20	0.20 - 1.05	-	1.05 - 1.15*
TP31	0.00 - 0.15	-	-	0.15 - 1.60	-	1.60 - 1.80*
TP32	0.00 - 0.20	-	-	0.20 - 0.30	-	-
TP33	-	0.00 - 0.10	-	0.10 - 0.80	0.80 - 1.10	1.10 - 1.40

Notes:

^ = Slow to very slow progress, close to practical refusal of 14 tonne or 5 tonne excavator on Extremely to Highly Weathered Rock.

4.0 Laboratory Testing

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

- (11 no.) Shrink / Swell tests;
- (10 no.) Emerson Class tests;
- (5 no.) California Bearing Ratio (4 day soaked) & Standard Compaction.

Results of the laboratory testing are presented in Appendix B, with a summary of the Shrink/Swell, Emerson Class and CBR test results presented in Table 3, Table 4 and Table 5.

^{* =} Refusal or Practical refusal of 14 tonne or 5 tonne excavator met on Highly Weathered Rock.

TABLE 3 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

Location	Depth (m)	Material Description	I _{ss} (%)
TP10	0.80 – 1.00	(CH) Sandy CLAY	2.1
TP11	0.50 – 0.68	(CH) Sandy CLAY	0.8
TP12	0.50 – 0.75	(CI) Sandy CLAY	2.5
TP17	0.30 - 0.50	(CI) Sandy CLAY	0.5
TP18	0.50 - 0.90	(CL) Sandy CLAY	1.3
TP20	0.50 – 0.75	(CI) Sandy CLAY	2.5
TP21	0.50 - 0.68	(CI) Sandy CLAY	2.8
TP23	0.40 - 0.70	(CI) Sandy CLAY	1.8
TP27	0.20 - 0.50	(CH) CLAY	1.5
TP31	0.30 - 0.60	(CH) CLAY	2.7
TP33	0.30 - 0.60	(CH) CLAY	0.4

TABLE 4 – SUMMARY OF EMERSON CLASS TESTING RESULTS

Location	Depth (m)	Material Description	EMERSON CLASS
TP03	0.30 - 0.60	(CH) Sandy CLAY	4
TP08	0.60 - 0.80	(CI) Sandy CLAY	2
TP11	0.50 – 0.70	(CH) Sandy CLAY	2
TP18	0.60 - 0.80	(CL) Sandy CLAY	2
TP20	0.50 – 0.75	(CI) Sandy CLAY	2
TP22	0.30 - 0.60	(CI) Sandy CLAY	2
TP23	0.40 - 0.70	(CI) Sandy CLAY	1
TP27	0.20 - 0.50	(CH) CLAY	3
TP29	0.30 - 0.50	(CH) CLAY	3
TP30	0.25 – 0.50	(CH) CLAY	3

TABLE 5 - SUMMARY OF CBR TESTING RESULTS

Location	Sample Depth (m)	Field Moisture Content (%)	Optimum Moisture Content (%)	Relationship of Field MC to OMC (%)	CBR (%)
TP03	0.30 - 0.50	23.8	23.6	0.2 wet	2.5
TP04	0.30 - 0.50	13.7	14.7	1.0 dry	2.0
TP27	0.20 - 0.50	19.8	20.9	1.1 dry	2.0
TP29	0.30 - 0.50	17.4	21.6	4.2 dry	2.5
TP30	0.25 – 0.50	27.1	27.5	0.4 dry	2.5

5.0 Discussion and Recommendations

5.1 Site Classification to AS2870-2011

Based on the results of the field work and laboratory testing the subject site of the proposed expansion of Cessnock Correctional Centre shown on Figure AD2 is classified in its current condition in accordance with AS2870-2011 'Residential Slabs and Footings', as **Class 'M'**, for areas not affected by filling.

Areas affected by fill are classified as **Class 'P'**. These areas are classified as **Class 'P'** due to the presence or inferred possible presence of fill / fill mounds and/or topsoil to depths of greater than 0.4m. There are no records of the placement or compaction of this material; therefore, it has been assessed to be uncontrolled fill. Approximate extent of filling observed is shown in Figure AD1.

The approximate extent of fill / fill mounds, of depths of greater than 0.4m was assessed based on a limited number of test pits and observations of site topography and survey plans provided by the client. If the extent needs to be known more accurately for planning, design or other purposes, then it should be investigated further.

It is envisaged that if removal of fill mounds is witnessed and documented by a geotechnical authority, then it is likely that these areas could be re-classified as **Class 'M'**.

It is understood that extensive earthworks are proposed to create a large level platform as part of the proposed development. As a preliminary guide, if the site is filled with site won Residual Soil (Unit 4), Weathered Rock (Unit 5 & 6) or similar material, carried out to 'Level 1' criteria as defined in Clause 8.2 – Section 8, of AS3798-2007, and incorporate a reasonable thickness of a non-reactive topsoil layer, these areas are likely to be re-classified as **Class 'H1'**.

It is noted that if fill materials of high reactivity (e.g. lss greater than about 2.5% to 3.0%) are used, re-graded areas may potentially be re-classified as **Class 'H2'**, dependent on depth of filling carried out.

Final site classification will be dependent on a number of factors, including depth of topsoil, depth of fill and residual soil, reactivity of the natural soil and any fill material placed, and the level of supervision carried out. Re-classification should be confirmed by the geotechnical authority at the time of construction following any site re-grade works.

A characteristic free surface movement of 20mm to 40mm is estimated for areas classified as **Class 'M'** in their existing condition.

A characteristic free surface movement of 40mm to 60mm is estimated for the areas which may be potentially re-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.

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.

If any localised 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.

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, wet or other potentially deleterious material.

5.2 Foundation Design Parameters

Strip / pad footings, raft slabs, and conventional bored piles are considered to be suitable foundation options for the proposed development.

Shallow footings founded on very stiff or better Residual Clay (Unit 4), or approved controlled fill (placed under Level 1 supervision in accordance with AS3798-2007) may be proportioned for a maximum allowable bearing pressure of 100kPa, provided they are founded below any existing uncontrolled fill, topsoil, deleterious or soft to firm material.

Shallow footings founded on weathered rock below the depth of backhoe / excavator practical refusal may be proportioned for a maximum allowable bearing pressure of 600kPa.

The recommended allowable (serviceability) bearing pressures assume that settlements will be less than about 1% of least footing width.

Table 6 presents a summary of founding parameters for deep footings (founding depth greater than 3 times maximum footing width) that have been adopted for the relevant materials.

TABLE 6 – SUMMARY OF DEEP FOOTING DESIGN PARAMETERS

Soil Description	Typical Depth Range (m)	Serviceability (Allowable) End Bearing Capacity (kPa)	Serviceability (Allowable) Shaft Adhesion (kPa)	Ultimate End Bearing Capacity (kPa)	Ultimate Shaft Adhesion (kPa)
Unit 1, 2 & 3 - Fill, Topsoil & Slopewash	0.00 to 0.25	-	-	-	-
Unit 4 & 5 - Residual Soil & Extremely Weathered Rock, or Level 1 Controlled Fill	0.25 to 2.60	150	25	450	50
Unit 6 - Highly to Moderately Weathered Rock	1.00 to 3.00 and greater	1000	75	3000	150
Unit 6 - Slightly Weathered to Fresh Rock	3.00 to 6.00 and greater	2000	150	6000	300

Notes:

- 1) Ultimate values occur at large settlements (>5% of minimum footing dimensions).
- 2) The ultimate pile parameters presented should be used in limit state pile design in accordance with Australian Standard AS 2159-2009, Piling Design and Installation.
- 3) A geotechnical strength reduction factor should be adopted for use with the above ultimate soil and rock parameters. A geotechnical strength reduction factor of 0.45 is recommended based on available information at this stage.
- 4) Piles should be no closer than 2.5 pile diameters apart.
- 5) It is expected that the settlement of deep footings proportioned as recommended above should not exceed about 1% of the effective pile diameter.

The base of the pile should be cleaned using a suitable bucket to remove spoil, as open flight augers usually cannot remove sufficient spoil to expose the majority of the pile base. If seepage occurs, piles should be dewatered prior to pouring concrete.

A suitably experienced geotechnical engineer should inspect the pile excavations to confirm founding conditions and design parameters prior to pouring concrete.

5.3 Pavement Design

5.3.1 Design Subgrade CBR Value

Based on the results of the field work, laboratory testing, and previous experience in the surrounding area, the following design California Bearing Ratio (CBR) values have been adopted for pavement thickness design.

TABLE 7 - DESIGN SUBGRADE CBR VALUES

Subgrade Material	Design CBR (%)	Comment
Residual Clay Soil	2.0	All pavement sections unless stated otherwise
Weathered Rock	8.0	Ripped and re-compacted

Fill placed at road subgrade level should be assessed by a geotechnical authority. If the fill is assessed to have a CBR different to that of the design CBR, then a revised pavement design will be required for that section.

Subgrade should be prepared in accordance with the site preparation requirements presented in Section 5.7.

5.3.2 Design Traffic Loadings

Design traffic loadings adopted for proposed administration area access roads and parking are in accordance with Cessnock City Council requirements for Urban Residential road type classifications in terms of equivalent standard axles (ESA's) as follows:

Access Roads and Parking Local Access 3 x 10⁵ ESA's

Traffic loadings for a 'Local Access' road have been adopted to allow for use by garbage trucks, delivery vehicles and trucks.

In the event that different design traffic loadings are applicable, then the pavement thickness designs presented in this report should be reviewed.

5.3.3 Flexible Pavement Thickness Design

Flexible pavement thickness design has been based on the procedures outlined in:

- Cessnock City Council Engineering Requirements for Development, 4.0 Road Design.
- Austroads, "Guide to Pavement Technology, Part 2: Pavement Structural Design".
- Australian Road Research Board, Special Report No. 41 (ARRB-SR41).

Flexible Pavement Thickness Designs are presented in Table 8.

Pavement Material Specification and Compaction Requirements are presented in Table 9.

TABLE 8 - FLEXIBLE PAVEMENT THICKNESS DESIGN SUMMARY

Road Classification	Local Access		
Road Section	Clay Subgrade	Select Fill	Rock Subgrade
Design Traffic Loading (ESA's)	3 x 10 ⁵	3 x 10 ⁵	3 x 10 ⁵
Design Subgrade CBR (%)	2.0	2.0	8.0
Wearing Course (mm)	30AC	30AC	30AC
Base Course (mm)	150	150	150
Subbase (mm)	360	150	150
Select Fill / Stabilised (mm)	-	300*	-
Total Thickness (mm)	540	630	330

Notes:

- 1) A 7mm primer seal should be placed over the base course prior to placement of the asphaltic concrete wearing course.
- 2) An allowance for subgrade replacement should be anticipated in any areas where poor, wet or saturated subgrade conditions are encountered.
- 3) The requirement for, and depth and extent of any subgrade replacement / select filling, should be confirmed by the geotechnical authority at the time of construction.
- 4) Where rock subgrade materials are encountered, the rock should be ripped and recompacted for a minimum depth of 300mm to break-up preferential drainage paths and provide a dense homogenous surface on which to construct the pavement.
- 5) Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

Alternate pavement designs have been provided for areas where poor subgrade (CBR = 2.0%) or wet subgrade conditions are encountered, including the option of incorporating a select layer to minimise overlying pavement thickness.

A bridging layer should be allowed for beneath the pavement where road pavements cross gullies and in any areas where poor, wet or saturated subgrade conditions are encountered. The requirement (if any) for bridging layers is likely to be dependent on the prevailing weather conditions at the time of construction.

Where weathered rock subgrade materials are encountered at subgrade level, the rock should be ripped and re-compacted for a minimum depth of 300mm to break-up preferential drainage paths and provide a dense homogenous surface on which to construct the pavement. Pavement thickness designs are provided for a weathered rock subgrade.

It is recommended that each construction length be boxed out to the minimum subgrade level required by the relevant pavement thickness design. Prior to pavement construction, the exposed subgrade should be assessed by the geotechnical authority to confirm the pavement thickness requirement for that section.

TABLE 9 - PAVEMENT MATERIAL SPECIFICATION AND COMPACTION REQUIREMENTS

Pavement Course	Material Specification	Compaction Requirements
Wearing Course (AC)	Cessnock City Council Spec.	Cessnock City Council Spec.
Base Course	CBR ≥ 80%, PI ≤ 6%	98% Modified (AS1289 5.2.1)
Subbase	CBR ≥ 30%, PI ≤ 12%	95% Modified (AS1289 5.2.1)
Select Fill / Stabilised Subgrade	Select, CBR ≥ 15%, PI ≤ 15%, max particle size 75mm	95% Modified (AS1289 5.2.1)
	Or	
	2% cement stabilised subbase material	
	Or	
	Stabilised Subgrade - lime stabilised with either 3% quicklime or 4% hydrated lime	
Subgrade (top 300mm)	Minimum CBR = Refer Table	100% Standard (AS1289 5.1.1)
Subgrade / Fill Below	Minimum CBR = Refer Table	95% Standard (AS1289 5.1.1)

Notes:

- 1) In accordance with Cessnock City Council Engineering Requirements for Development, pavement materials for sub-base and base course shall comply with A.R.R.B. Special Report No. 41 Section 5, "Pavement Materials".
- 2) CBR = California Bearing Ratio, PI = Plasticity Index.
- 3) Select Fill adopted will be dependent on subgrade moisture conditions.

5.3.4 Construction Considerations & Site Drainage

The enclosed pavement thickness designs assume the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. As a minimum, it is recommended that subsoil drains be installed:

- Along the high side of roads aligned across site slopes;
- Along both sides of roads aligned down slope.

Pavement surface and subsurface drainage should be carried out in accordance with Cessnock City Council, Engineering Requirements for Development.

Adequate surface and subsurface drainage should be installed and connected to the stormwater disposal system.

Inspection should be carried out by a geotechnical authority during construction to confirm the conditions assumed in this report and in the design.

Care should be taken to follow recommended construction practices when constructing new pavement adjacent to existing, including:

- A clean, vertical perpendicular surface at full depth should be cut for both transverse and longitudinal jointing. This will reduce the risk of plating and heaving effects on the pavement;
- Ensuring joints are not in wheel paths;
- Ensuring joints in sub-base / select layers are offset to joints in the base layer;
- Ramping between layers, and at the entry and exit points to the pavement, must be removed at all times. During construction, any temporary access ramps to properties or driveways must also be removed.

5.4 Excavation Conditions

The depths of fill, topsoil, slopewash, residual soils and weathered rock, together with depths of practical refusal of the 14 tonne or 5 tonne excavator where encountered are summarised in Table 2. In terms of excavation conditions, site materials can generally be divided into:

- Clayey and Granular Soils (Units 1, 2, 3 & 4). It is anticipated that these materials could be excavated by a conventional excavator or backhoe bucket;
- Weathered Rock (Unit 5 & 6). Rippability is dependent on rock strength, depth, degree of weathering and number of defects within the rock mass which can vary significantly.

It is anticipated that the Weathered Rock (Unit 5 & 6) material encountered could be excavated by conventional 14 to 20 tonne excavator or equivalent at least to the depths indicated on the appended test pit logs.

It is expected that material below the depth of 14 tonne / 5 tonne excavator bucket refusal will be excavatable by ripping to some greater depth.

The five boreholes (BH01 to BH05) indicate that the majority of the rock that is likely to be encountered will be sandstone, pebbly sandstone and interlaminated siltstone and sandstone, of medium to high rock strength, with variable fracture spacings.

Below depths of about 3m to 4m (up to about 5m in places), rock strength and defect spacing increases and it is assessed that the that ripping may become difficult. If these bands are highly fractured, they should still be rippable, but may require additional effort such as impact ripping or a larger dozer. It is recommended that an allowance for rock breakers or pre-splitting prior to ripping be made for areas where such hard bands may be encountered.

The results from the boreholes have been plotted indicatively on Figure AD3 on the excavatability graph published as Figure 10 in the paper by G. S. Pettifer & P.G. Fookes "A revision of the graphical method for assessing the excavatability of rock", 1994. This indicates that rock to depths of about 3m to 4m (up to about 5m in places) may be mostly classed as "easy ripping" to "hard ripping" requiring machines equivalent to a Caterpillar D8 Tractor, or larger, equipped with a ripping tine.

It also indicates that below depths of about 3m to 4m conditions are mostly expected to range from "hard ripping" to "blasting required". It would be expected that in a large bulk excavation such as that proposed, where ripping directions can be adjusted readily to optimise ripping direction relative to fracture orientation, the majority of rock would be excavatable by a large dozer such as a Caterpillar D9 to D11 or equivalent equipped with a single ripping tine, with allowance for impact ripping, hydraulic breaking and/or pre-splitting in places. Blasting may be required in some areas to achieve normal rates of production.

Factors other than geotechnical conditions may influence selection of excavation methods. It may be worthwhile attempting ripping using large machinery before resorting to blasting.

Conditions least conducive to ripping were encountered in borehole BH03, where medium to high strength rock was encountered with a large defect spacing possibly in the order of 3m.

The discontinuity spacing index has been estimated to an approximate level based on the defect spacings on the engineering logs and core photographs. The approximate range of point load strength index has been adopted based on the results of laboratory point load tests on Unit 6 Weathered Rock recovered from boreholes BH01 to BH05.

Based on Figure AD3, it is assessed that rippability will be highly dependent on three dimensional defect spacing. This assessment has been largely based on the results of boreholes which may be considered to provide 1 dimensional defect spacing information; therefore, it is recommended that consideration be given to potential for different conditions to be encountered when selecting excavation methods and equipment.

It is recommended that additional targeted investigations are carried out if a better understanding of potential variations in geotechnical conditions are critical to selection of excavation methods and equipment. Only field trials will determine conclusively whether a rock mass can or cannot be excavated using particular methods or plant.

Groundwater may exist at localised areas of the site such as within the topsoil / slopewash profile, from water perched above the residual clay / bedrock profile, or in areas of former drainage channels. It is possible that slow water inflow may be encountered from such layers, particularly if earthworks are carried out during or following periods of wet weather.

Care should be taken not to disturb or destabilise existing underground services or structures.

5.5 Recommended Batter Slopes

Recommended batter slopes for each inferred geotechnical unit are summarised in Table 12.

TABLE 10 - RECOMMENDED BATTER SLOPES

GEOTECHNICAL		MAXIMUM SLOPE OF EXCAVATED UNSUPPORTED BATTER		
UNIT	MATERIAL TYPE	Temporary Excavations *	Permanent Excavations	
UNIT 1, 2 & 3	Fill, Topsoil & Slopewash	1V:1.5H	1V:3H	
UNIT 4	Residual Soil	1V:1H	1V:2H	
UNIT 5	Extremely Weathered Rock	1V:0.5H	1V:1.5H	
UNIT 6	Highly Weathered Rock	1V:0.5H	1V:1H	

NOTE:

The safe working procedures of Work Cover NSW Excavation work code of practice, dated July 2014 should be followed.

^{*} Subject to inspection during excavation to check for water inflow, adversely orientated defects or other conditions that could affect stability of the slope.

5.6 Suitability of Site Materials for Re-Use as Fill

The following comments are made with respect to suitability of site materials for re-use as fill:

- Unit 1 Fill material may be suitable for re-use as general fill for engineering purposes, however this would be subject to contamination testing and waste classification (contamination assessment being carried out and reported separately);
- Unit 2 Topsoil materials are expected to be suitable for landscaping purposes only;
- Unit 3 Slopewash may be variable and suitability for re-use should be confirmed at the time
 of construction. These materials will likely require some moisture conditioning;
- Unit 4 Residual Soils are generally expected to be suitable for re-use as general fill for engineering purposes. These materials may require some moisture conditioning;
- Unit 5 Extremely Weathered Rock and Unit 6 Highly Weathered Rock are generally
 expected to be suitable for re-use as general fill for engineering purposes. These materials
 may require sorting or processing by crushing / screening depending upon excavation
 methods, source material characteristics and proposed uses.

Final selection of fill materials should consider properties such as reactivity which is typically moderate for site won Unit 4 Residual Soils, and low to moderate for site won Unit 5 Extremely Weathered Rock and Unit 6 Highly Weathered Rock.

Results of Emerson testing provide an indication into potential susceptibility to erosion. The results indicate that most site materials are likely to be dispersive. This means that erosion protection is likely to be required to prevent erosion by rainfall etc. The addition of gypsum may provide improved performance in some cases.

The suitability of material for re-use should be assessed and confirmed by the geotechnical authority at the time of construction.

5.7 Site Preparation

Site preparation and earthworks suitable for pavement support and site re-grading should consist of:

- Following bulk excavation to proposed subgrade level, all areas of proposed pavement construction or site re-grading should be stripped to remove all existing uncontrolled fill, vegetation, topsoil, root affected or other potentially deleterious materials;
- Stripping is generally expected to be required to depths of about 0.1m to 0.3m to remove topsoil and root affected material.
- Stripping of fill material in addition to topsoil and root affected material is anticipated in areas affected by fill mounds as indicated on Figure AD1;
- Additional stripping may be required in any areas where poor, wet or saturated subgrade conditions are encountered;
- Following stripping, the exposed subgrade should be proof rolled (minimum 10 tonne static
 roller), to identify any wet or excessively deflecting material. Any such areas should be
 over excavated and backfilled with an approved select material;
- The moisture content of the subgrade materials and therefore the need for moisture conditioning or over-excavation and replacement, will be largely dependent on preexisting and prevailing weather conditions at the time of construction;

- Subgrade preparation should be carried out using a tracked excavator equipped with a smooth sided ('gummy') bucket to minimise the risk of over-disturbance of soils;
- Protect the area after subgrade preparation to maintain moisture content as far as practicable. The placement of subbase gravel would normally provide adequate protection;
- Site preparation should include provision of drainage and erosion control as required, as well as sedimentation control measures.

Subgrade soils are likely to have a propensity to soften relatively quickly with moisture ingress; therefore, it is particularly important that care be taken to ensure that the subgrade is not exposed to wet conditions.

At the time of the field investigation, moisture content for the clay subgrade material tested varied from 0.2% wet to 4.2% dry of standard Optimum Moisture Content (OMC). It should be anticipated that some moisture conditioning of the subgrade may be necessary prior to compaction and placement of pavement materials.

The required time period to prepare the subgrade is likely to be dependent on the prevailing weather conditions at the time of construction.

If over wet subgrades exist at the time of construction or deleterious fill materials are encountered at subgrade level, these materials should be over-excavated and be replaced with a minimum depth of 300mm of well graded granular select material with CBR of greater than 15%, or a 2% cement stabilised subbase material. The selection of select material where required will be dependent on moisture condition of subgrades at the time of construction.

5.8 Fill Construction Procedures

Earthworks for pavement construction or support of foundations should consist of the following measures:

- Approved fill beneath pavements should be compacted in layers not exceeding 300mm loose thickness to the compaction requirements provided in Table 9;
- The top 300mm of natural subgrade below pavements or the final 300mm of road subgrade fill should be compacted to provide a subgrade that is within the moisture range of 60% to 90% of Optimum Moisture Content (OMC);
- Site fill beneath structures should be compacted to a minimum density ratio of 98%
 Standard Compaction within ±2% of OMC in cohesive soils;
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;
- Where fill is to be placed on slopes in excess of 1V:8H (7°), a prepared surface should be benched or stepped into the natural slope;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 'Guidelines for Earthworks for Commercial and Residential Developments'.

6.0 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 AD1:

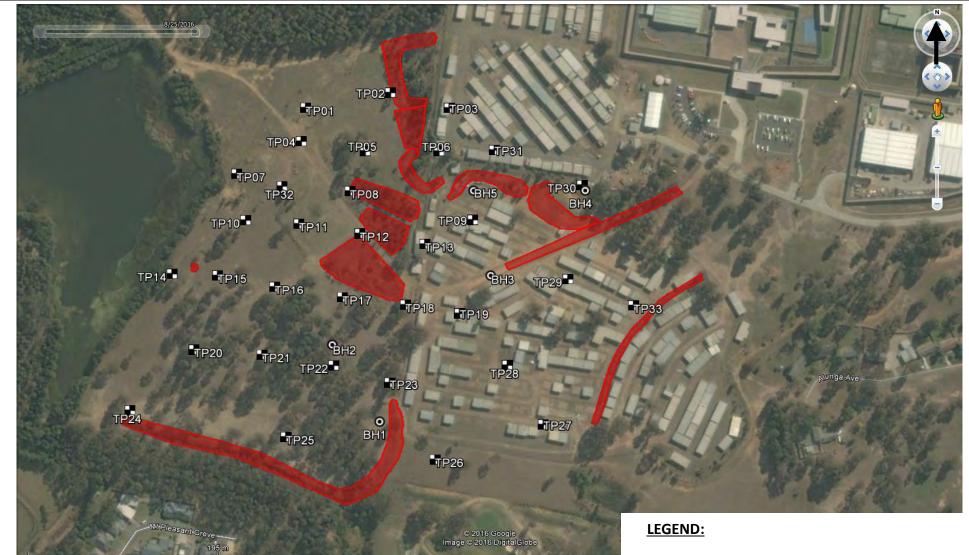
Approximate Test Locations

FIGURE AD2:

Approximate Test Locations with Concept Overlay

FIGURE AD3:

Excavatability Graph



Based on Google Earth image.

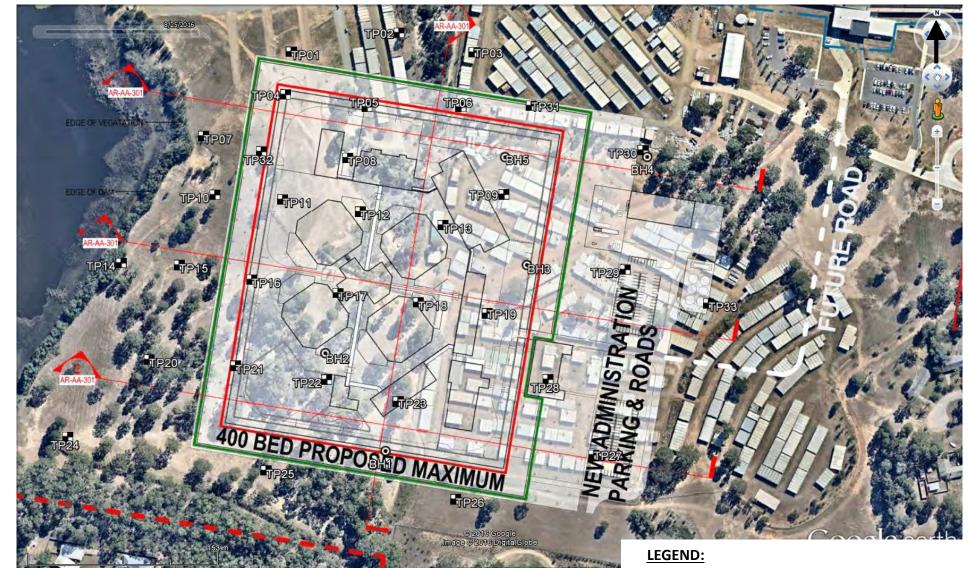


Approximate borehole location.

Approximate area of fill mounds/stockpiles with depth of about 0.4m or more.



Client:	LEND LEASE	Drawing No:	FIGURE AD1
Project:	PROPOSED EXPANSION	Project No:	NEW16P-0119
Location:	CESSNOCK CORRECTIONAL CENTRE	Scale:	AS SHOWN
Title:	APPROXIMATE TEST LOCATIONS	Date:	9/09/2016



Based on concept plan provided by client (by email dated 25/08/16) overlain approximately on Google Earth image by Qualtest.



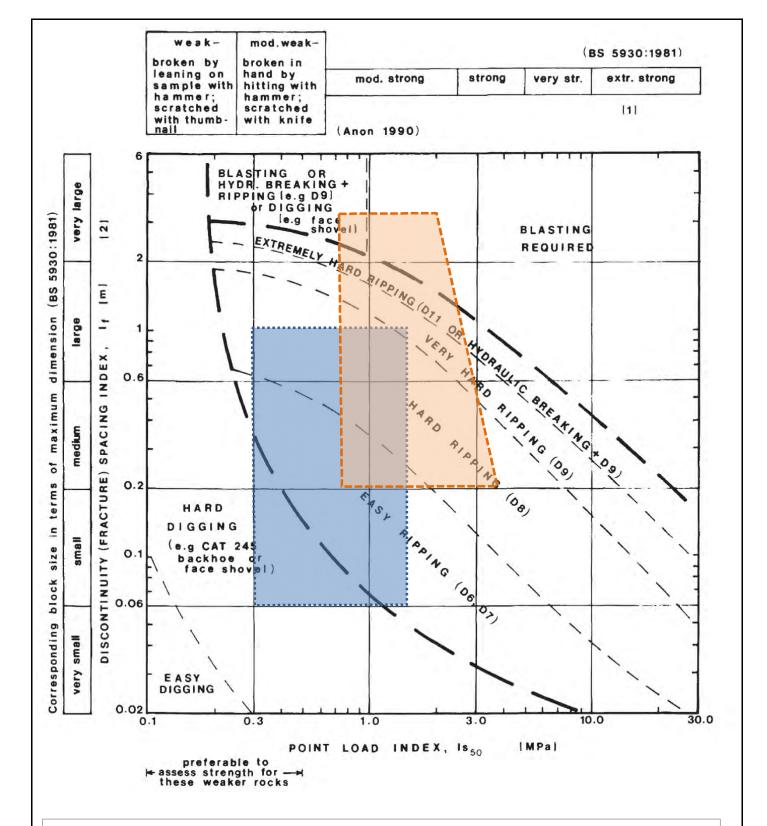
Approximate test pit location.



Approximate borehole location.



Client:	LEND LEASE	Drawing No:	FIGURE AD2
Project:	PROPOSED EXPANSION	Project No:	NEW16P-0119
Location:	CESSNOCK CORRECTIONAL CENTRE	Scale:	as shown
Title:	APPROXIMATE TEST LOCATIONS WITH CONCEPT OVERLAY	Date:	9/09/2016



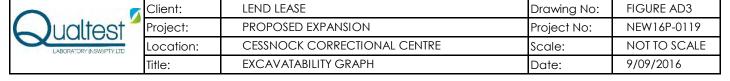
LEGEND



Indicative range of conditions in BH01 to BH05 to depths of about 3m to 4m (about 5m in places).

Indicative range of conditions in BH01 to BH05 to depths below about 3m to 4m (about 5m in places).

Based on "Revised excavatability graph" by G. S. Pettifer & P. G. Fookes, 1994.



APPENDIX A:

Results of Field Investigations



Test Pit & Borehole Locations

Client LEND LEASE

Project PROPOSED EXPANSION

Location CESSNOCK CORRECTIONAL CENTRE

Job Number: NEW16P-0119

Universal Grid Reference

Grid Zone 56H

Test Pit / Borehole No.	Easting (m) E	Northing (m) S
BH01	343908	6367317
BH02	343858	6367396
BH03	344021	6367470
BH04	344117	6367560
BH05	344002	6367558
TP01	343827	6367641
TP02	343914	6367658
TP03	343975	6367643
TP04	343823	6367606
TP05	343889	6367597
TP06	343965	6367598
TP07	343757	6367571
TP08	343874	6367555
TP09	344001	6367527
TP10	343767	6367523
TP11	343822	6367520
TP12	343885	6367511
TP13	343952	6367501
TP14	343692	6367466
TP15	343739	6367465
TP16	343798	6367454
TP17	343868	6367444
TP18	343933	6367437
TP19	343989	6367429
TP20	343716	6367387
TP21	343786	6367383
TP22	343860	6367373
TP23	343918	6367356
TP24	343651	6367323
TP25	343812	6367298
TP26	343966	6367277
TP27	344077	6367315
TP28	344039	6367376
TP29	344100	6367467
TP30	344114	6367567
TP31	344022	6367600
TP32	343804	6367559
TP33	344168	6367440



LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

PROJECT: PROPOSED EXPANSION

JOB NO:

TEST PIT NO:

1 OF 1

TP01

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NEW16P-0119

DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

		IENT TYPE IT LENGTH		2.0 m		IDTH:		FACE RL: UM:					
	Dril	ling and Sam	npling				Material description and profile information	I			Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasti characteristics,colour,minor compon		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		GC	FILL: Sandy Clayey GRAVEL - fine to m grained, sub-angular to sub-rounded, dai grey-brown, trace silt, root affected.		М				FILL - TOPSOIL
	red	0.30m B E		-		СН	FILL: Sandy CLAY - medium to high plas red-brown and dark brown, fine grained s fine to coarse grained gravel, sub-angula sub-rounded.	and, with			HP	420	FILL
ш	Not Encountered	(<u>0.45m</u>		0. <u>5</u> -		СН	Sandy CLAY - medium to high plasticity, orange-brown and orange, fine grained s	 and.			HP	500	RESIDUAL SOIL
	Z			- 1.0_		CL	Sandy CLAY / Clayey SAND - low to me plasticity, grey and orange-brown, fine gr	dium ained sand.	M < W _P	Н			
				-			1.15m		D - M				EXTREMELY TO HIGHLY
Q1LB11.1GLB Log NON-CORED BOREHOLE - 1ESI PIT NEW16P-0119 - 1ESI PIT LOGS; GPJ < <drawning-lie>> 09/09/2016 17:12 8:30:003 Datgel Lab and in Situ Tool State</drawning-lie>				- 1.5_ - - 2.0_ - - 2.5_			Extremely Weathered SANDSTONE, bre into Clayey SAND - fine grained, grey an orange-brown, estimated very low streng Hole Terminated at 1.20 m Practical Refusal	d	5-191				WEATHERED ROCK
LEG Wat	Wat (Dat	ter Level te and time sh ter Inflow ter Outflow	nown)	Notes, Sar U ₅₀ CBR E ASS	50mm Bulk s Enviro (Glass Acid S (Plast	Diame ample f nmenta jar, sea Sulfate S	ter tube sample for CBR testing il sample aled and chilled on site) Soil Sample air expelled, chilled)	S S F F St S VSt V	ncy /ery Soft Soft Firm Stiff /ery Stiff Hard		<2 2 5 1 2 2	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
	G tra D	radational or ansitional stra efinitive or dis rata change	ta	Field Test PID DCP(x-y) HP	Photo Dynar	nic pene	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)	Density	V L ME D VD	L() N D	ery Lo oose lediun ense ery Do	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

PROJECT: PROPOSED EXPANSION

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		MENT TYPE		CAT - 2.0 m		NNE E I DTH :	EXCAVATOR 0.7 m		SURFACE R DATUM:	L:					
۳		lling and Sam		2.0 111		U111.	-	iption and profile inforr					Fiel	d Test	
МЕТНОБ	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DES	CRIPTION: Soil type, ristics, colour, minor cor	plasticity/partic	le	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		sc	with fine to m	O - fine to medium grain ledium grained gravel, root affected.	ned, dark browr sub-angular to	٦,	М				TOPSOIL
< < ChrawingFile>> 09/09/2016 17:12 8.30.003 Datgel Lab and in Situ Tool E	Not Encountered					СH	orange-browr grained sand.	/ Clayey SAND - low t	fine to medium	-	M < W _P	н	HP	550 520 450	RESIDUAL SOIL
- TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ				2.0_ - - - 2.5_ -			brown, estima Hole Termina Refusal	E - fine grained, dark g ated low stength. ted at 1.90 m			M				HIGHLY WEATHERED ROCK
QT LIB 1.1.GLB Log NON-CORED BOREHOLE	(Da (Da Wa Wa Wa Cata Ch tr	ter Level te and time sh ter Inflow ter Outflow anges bradational or ansitional strat tefinitive or dist trata change	own)	Notes, Sar U ₅₀ CBR E ASS B Field Test PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S S Photoi Dynan	Diame ample finmenta jar, sea sulfate S c bag, a sample onisationic pener	ter tube sample for CBR testing il sample aled and chilled on site Soil Sample air expelled, chilled) on detector reading (pretrometer test (test desemble)	pm) pth interval shown)	Cons VS S F St VSt H Fb Dens	Sc Fir St Ve Ha Fri	ery Soft oft rm	V Lc) M D	25 50 10 20 20 20 ery Lo	5 - 50 0 - 100 00 - 200 00 - 400 400 pose	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

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TP03

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CAT - 14 TONNE EXCAVATOR SURFACE RL:

LOCATION: CESSNOCK CORRECTIONAL CENTRE

		MENT TYPE					EXCAVATOR	SURFA						
TE		IT LENGTI		2.0 m	W	IDTH:		DATUM	1:			1		
	Dri	Drilling and Sampling					Material descriptio	n and profile information		Ι		Field	d Test	
МЕТНОБ	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		PTION: Soil type, plasticity, cs,colour,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E / QC1 / QC2 0.10m		_		sc	medium grained s	ow plasticity, dark grey-brov sand, trace fine to coarse g lar, with silt, root affected.	vn, fine to rained	М				TOPSOIL
		0.20m E 0.30m 0.40m B 0.50m		- - 0.5_			Sandy CLAY - m orange-brown to	edium to high plasticiity, red-brown, fine grained san own to orange-brown and gr		M > W _P	VSt	HP HP	280	RESIDUAL SOIL
				-						M ~ W _P		HP HP	480 - 500 560	
INGTITIES VINOSIZATO 17.12 G.NUCOS DRIÇEI LAD ANU III SIU TOTI	Not Encountered			1.0		СН	1.80m			M < W _P	н	nr	360	
				- 2.0_ - -			Extremely Weath into Gravelly Clay some orange-bro	ered SANDSTONE, breaks yey SAND - fine grained, gr wn, fine to medium grained ients), estimated very low s	ey, with gravel	М	D - VD			EXTREMELY TO HIGHLY WEATHERED ROCK
				2.5			Hole Terminated Very slow progres							
- 150 FI: NEW 10				-										
Wa Wa	Wa (Da	ter Level te and time sh ter Inflow ter Outflow	hown)	Notes, Sar U ₅₀ CBR E ASS	50mm Bulk s Enviro (Glass Acid S (Plast	Diame ample nmenta jar, se Sulfate S	ter tube sample for CBR testing al sample alled and chilled on site) Soil Sample air expelled, chilled)		S So F Fi St St VSt Ve H Ha	ery Soft oft rm tiff ery Stiff ard iable		<2 25 50 10 20	CS (kPa) 25 5 - 50 0 - 100 00 - 200 00 - 400	D Dry M Moist W Wet W _p Plastic Limit
	G tr D	anges tradational or ansitional stra refinitive or dis trata change	ata	Field Tests PID DCP(x-y) HP	<u>s</u> Photo Dynar	ionisati	on detector reading (ppm) etrometer test (test depth i emeter test (UCS kPa)	interval shown)	<u>Density</u>	V L MD D	Lo M D	ery Lo pose ediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

PROJECT: PROPOSED EXPANSION

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NEW16P-0119

TP04

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Ë		ling and Sam		2.0 111	•••		Material description a		·-			Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPT	ION: Soil type, plasticity, colour,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		_		GP	40mm), dark brown, clay, root affected.	EL - fine to coarse graine fine to coarse grained s		М				FILL - TOPSOIL
GILBPT.1.SEB LOG NON-CORED BORRENOLE - TEST PIT NEWTOP-2019 - TEST PIT LOGS: GF7 << Drawing-Ties> US/US/US Dargel Lab and in Situ 1001 E	Not Encountered	0.50m B 0.80m		1.5_ 		CH	sand. Becoming grey and	ome red-brown, fine grain	wn.	M < Wp	H D - VC	HP	500 >600	RESIDUAL SOIL
EW107-0118 - 1E01 F11 CG5.G13				2.5_			2.40m Hole Terminated at 2 Very slow progress	2.40 m						
LEC Water and the street of th	Wai (Dai - Wai I Wai ata Cha G tra	ter Level te and time sh ter Inflow ter Outflow ter Outflow anges radational or ansitional stra efinitive or dis rata change	nown)	Notes, Sar U ₅₀ CBR E ASS B Field Test: PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S Photo Dynar	Diame ample inmenta ign, se Sulfate S ic bag, a sample ionisationic pen	ter tube sample for CBR testing il sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth inte	rval shown)	S S F Fi St S VSt V H H	ery Soft oft imm titff ery Stifff ard riable V L MC D VC	V L(<2 25 50 10 20 >2 ery Lo	n Dense	D Dry M Moist W Wet W _p Plastic Limit U _L Liquid Limit Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP05

BE

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DATE: 9/8/16

		IENT TYPE		CAT - 2.0 m		NNE E I dth :	EXCAVATOR 0.7 m	SURFA DATUM						
H		ling and San						n and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRI	PTION: Soil type, plasticity ss,colour,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m / 0.45m		- - 0.5		SM	mediúm grained s gravel, sub-round	plasticity, grey-brown, fine sand, trace fine to medium led, trace rootlets.		М				SLOPE WASH
ш	Not Encountered	<u>0.55m</u>		- - 1.0_		СН	Sandy CLAY - me red-brown, fine gr	edium plasticity, orange-bro rained sand.	own and	M < w _p	н	· HP	>600	RESIDUAL SÕIL
OT LIB 17.1GLB LOG NON-CORED BOREHOLE - TEST PIT NEW18P-0119 - TEST PIT LOGS.GFU. <- ChrawingFile>> 09/09/2016 17:12 8.30.003 Datgel Lab and in Situ Tool Signature - 12 8.30.				1.5_ -			Becoming grey as 1.80m Hole Terminated Very slow progres		wn.			HP	>600	
GPJ < <drawingfile>> 09/09/2016</drawingfile>				2.0_			very slow progres							
TEST PIT NEW 16P-0119 - TEST PIT LOGS.				2.5_ - - -										
Wat Stra	∠ Wa (Da – Wa 4 Wa ata Cha	ter Level te and time sh ter Inflow ter Outflow anges radational or ansitional stra	hown)	Notes, Sar U ₅₀ CBR E ASS B Field Tests	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample f nmenta jar, se sulfate s c bag, a sample	ter tube sample for CBR testing I sample aled and chilled on site) soil Sample air expelled, chilled) on detector reading (ppm)		S S F F St S VSt V H H	locy Very Soft oft irm ctiff Very Stiff lard riable V L	·	<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
Q1 LIB 1.1.	D	efinitive or dis rata change		DCP(x-y) HP	Dynan	nic pen	etrometer test (test depth i meter test (UCS kPa)	nterval shown)		ME D VE	D M		n Dense ense	



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LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

		IENT TYPE: IT LENGTH:		CAT - 2.0 m		NNE E		JRFACE RL: ATUM:					
	Dril	ling and Samp	ling				Material description and profile informa	tion			Fiel	ld Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, pla characteristics,colour,minor comp		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
	Not Encountered	E 0.10m ,		1.0_ 		GC CH	FILL: Sandy Clayey GRAVEL - fine to grained, sub-angular to angular, dark to medium grained sand, fines of med root affected. Sandy CLAY - medium to high plastic orange-brown to red-brown, fine grain Becoming grey and orange-brown to red-brown fine grain Extremely Weathered SANDSTONE, into Gravelly Clayey SAND - fine grain some orange-brown, fine to medium g (sandstone fragments), estimated very	grey-brown, fine um plasticity, ity, ed sand. ed-brown.	M < w ~ M < w > M	Н	HP HP	460 530 >600	RESIDUAL SOIL RETREMELY WEATHERED ROCK
Wat	Wai (Dai - Wai Wai ta Cha G	ter Level te and time shower Inflow ter Outflow unges ransitional strata	wn)	Notes, Sar U _∞ CBR E ASS B Field Test PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid S (Plast Bulk S	Diame ample to numental jar, see sulfate Sc bag, a sample onisatio	Hole Terminated at 2.60 m Very slow progress iter tube sample for CBR testing all sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown)	S S F F St S VSt N	ncy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L MD	V	25 50 10 20 >4 ery Lo	CS (kPa) 25 5 - 50 0 - 100 00 - 200 00 - 400 400 pose m Dense	D Dry M Moist W Wet Wp Plastic Limit Liquid Limit Density Index <15% Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

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						SURFA DATUN								
	Dril	ling and Sam	pling				Material description a	and profile information				Fiel	d Test	t
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		ION: Soil type, plasticity colour,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		_		SP	affected.	se grained, brown, trace	silt, root					TOPSOIL - SLOPE WASH
		0.40m		- 0.5		SC SP	0.40m SAND - fine to medi	to medium grained, dark y, trace silt. um grained, grey-brown,		M	MD	-		SLOPE WASH
		(0.50m		-			silt. 0.55m Sandy CLAY - medi dark grey, fine grain	um plasticity, orange-bro	own and		St	HP	180	RESIDUAL SOIL
	ntered			- 1.0		CI	1.00m	od odra.		M v W	VSt	HP HP HP	180 280 320	
В	Not Encountered			- - 1.5_ - - - 2.0_		CL	Sandy CLAY / Claye orange-brown, fine o	ey SAND - low plasticity, grained sand.	grey and	M < Wp	н			
				- 2.5_ - -			2.10m SANDSTONE - fine	to coarse grained, orang estimated low to medium 2.10 m		M				HIGHLY WEATHERED \ROCK
Wate	Wat (Dat Wat Wat La Cha	ter Level te and time sh ter Inflow ter Outflow anges radational or ansitional strai		Notes, Sar U ₅₀ CBR E ASS B Field Tests	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample nmenta jar, se sulfate s c bag, ample	ter tube sample for CBR testing Il sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm)		S S F F St S VSt \	rcy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L	·	<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
	_ D	efinitive or dist		DCP(x-y) HP	-		etrometer test (test depth inte meter test (UCS kPa)	rval shown)		ME D VD	D	lediun ense ery De	n Dense ense	Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



CLIENT: LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP08

ΒE

JOB NO: LOGGED BY: NEW16P-0119

DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

		IT LENGTH		2.0 m	w		0.7 m DATUM Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics, colour, minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		_		СН	FILL: Sandy CLAY - medium to high plastic orange-brown with some grey, fine grained fine to coase grained gravel, sub-angular.			Н			FILL
				-			O.20m Sandy SILT / Sitty SAND - low plasticity, grifine grained sand, trace rootlets.	ey-brown,			HP	>600	SLOPE WASH
		0.50m		0.5		SM	Becoming grey.			MD - D			
	ered	8:68m B 0.80m		-			Sandy CLAY / Clayey SAND - medium plas orange-brown with some grey, fine grained	ticity, sand.	Ν _P		HP	>600	RESIDUAL SOIL
ш	Not Encountered			1. <u>0</u>					M < Wp				
				- - 1.5_		CI				Н			
				- - -			1.80m	-,,			-		EXTREMELY WEATHER!
				2.0		SC	Extremely weathered SANDSTONE, breaks Clayey SAND - fine to medium grained, ora grey, with fine to medium grained gravel, es very low strength.	nge and	М				ROCK
				-			Hole Terminated at 2.00 m Very slow progress						
				2.5									
				-									
				-									
Wate	Wat (Dat	ter Level te and time sh	own)	Notes, Sar U ₅₀ CBR E	50mm Bulk s Enviro (Glass	Diame ample nmenta jar, se	eter tube sample for CBR testing al sample aled and chilled on site)	S S F F St S	ery Soft oft irm tiff		<2 25 50 10	CS (kPa 25 5 - 50 0 - 100 00 - 200	D Dry M Moist W Wet W _p Plastic Limit
-	l Wat ta Cha	ter Outflow		ASS B Field Test	(Plast Bulk S		Soil Sample air expelled, chilled)	н н	ery Stiff lard riable V			00 - 400 400 oose	Density Index <15%
	tra Do	radational of ansitional strat efinitive or dist rata change	a	PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)		L ME D	Lo M	oose	n Dense	Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP09

ΒE

JOB NO: LOGGED BY: NEW16P-0119

DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

	Drill	ling and Sam	oling		_		Material description and profile information				Field	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		SM	Silty SAND - fine to medium grained, grey-t clay, with fine to medium grained gravel, su to sub-rounded, root affected.	orown, with b-angular	М				TOPSOIL
Э	Not Encountered			1.0		CH	Sandy CLAY - medium to high plasticity, orange-brown with some red-brown, fine grasand. Becoming grey and orange-brown to red-brown to red-brown to red-brown to brown, fine to medium grave orange-brown to brown, fine to medium grave.	own.	M < W _p	VSt - H	유 유 유 유 유 유 유 유 유 유 유 유 유 유 유 유 유 유 유	350 280 300 360 380 410	RESIDUAL SOIL
LEG	END:			2.5	50mm	Diame	ter tube sample	1	Very Soft		<2		D Dry
¥ -	Wat (Dat Wat Wat ta Cha	radational or	own)	CBR E ASS B Field Tests PID	Enviro (Glass Acid S (Plasti Bulk S	nmenta jar, se sulfate s c bag, a sample	or CBR testing Il sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm)	F F St S VSt \ H H	Soft Firm Stiff Very Stiff Hard Friable V		50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400 pose	P P
	_ De	ansitional strata efinitive or disti rata change	1 1	DCP(x-y) HP	Dynan	nic pen	etrometer test (test depth interval shown) meter test (UCS kPa)		MD D	M		n Dense	•



LEND LEASE

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TP10

BE

LOGGED BY:

NEW16P-0119

LOCATION: CESSNOCK CORRECTIONAL CENTRE DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

		IENT TYPE IT LENGTI		CAT - 2.0 m		NNE E ' IDTH :	EXCAVATOR 0.7 m	SURFA DATUM						
		ling and Sam					Material description and					Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION characteristics,colo	N: Soil type, plasticity, our,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		SC	Clayey SAND - fine to trace silt, root affected.		brown,	М				TOPSOIL
		0.80m		- 0. <u>5</u> - -		CH	Sandy CLAY - medium and orange-brown, fine Becoming orange-brow	grained sand.	k brown	M ~ W _P	VSt	HP HP HP HP	210 220 230 280 300	RESIDUAL SOIL
OT LIB 1.1.GLB Log NON-CORED BORRHOLE - TEST PIT NEW16P-0119 - TEST PIT LOGS. GPJ <-DrawingFile>> 09/09/2016 17:13 8.30,003 Datget Lab and in Situ Tool IST No. IST IMA	Not Encountered	U50 1.00m		1.0 <u></u>		CL	Sandy CLAY / Clayey S brown to orange-brown			M < W _P	Н			
TEST PIT NEW16P-0119 - 1 EST PIT LOGS.G	GEND:			2.5	mples ar	d Tests	2.40m Hole Terminated at 2.4 Very slow progress	0 m	Consister	ncy		U	CS (kPa) Moisture Condition
Mad Water Cored Boxel Mon-Cored Boxel Mad Strain St	. Wa (Da - Wa ■ Wa ata Cha G tra	ter Level te and time sh ter Inflow ter Outflow anges radational or ansitional stra efinitive or dis rata change	nown)	U ₅₀ CBR E ASS B Field Test PID DCP(x-y) HP	Bulk s Enviro (Glass Acid s (Plast Bulk s E Photo Dynai	sample formentals jar, sea Sulfate Stic bag, a Sample sionisationic penerals	ter tube sample or CBR testing I sample aled and chilled on site) soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interva meter test (UCS kPa)	l shown)	S S F Fi St S VSt V H H	ery Soft oft imm tiff ery Stiff ard riable V L ME D VD	V L:) M D	50 10 20 >4 ery Lo	5 - 50 0 - 100 00 - 200 00 - 400 400 pose	W _L Liquid Limit Density Index <15% Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP11

LOGGED BY: ΒE

DATE: 9/8/16

	MENT TYPE: PIT LENGTH:		AT - 1 .0 m		NNE E DTH:	EXCAVATOR 0.7 m	SURFACE RL: DATUM:					
Dr	rilling and Samp	ling				Material description and profile	information			Fiel	d Test	
METHOD	SAMPLES		EPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil characteristics,colour,mir		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
	E (0.10m				SM	Silty SAND - fine to medium of affected.	rained, grey-brown, roo	ot M				TOPSOIL
E Not Encountered	0.50m B U50 0.68m 1.20m B 1.50m		0.5		CL	Sandy CLAY - medium to hig and orange-brown, fine grains Becoming pale grey and oran 1.20m Sandy CLAY / Clayey SAND plasticity, orange-brown to brigrained sand. Hole Terminated at 2.30 m Very slow progress	ge-brown.	M < W _P - M > W _P	VSt		210 280 310 300 390 410	RESIDUAL SOIL
— (D:	ater Level ate and time sho ater Inflow ater Outflow	U _{so} CBR E ASS	d Tests	Bulk sa Enviror (Glass Acid S (Plastic Bulk S	Diame ample f nmenta jar, se ulfate s c bag, a ample	ter tube sample or CBR testing I sample aled and chilled on site) Soil Sample air expelled, chilled)	Consist VS S F St VSt H Fb Density	Very Soft Soft Firm Stiff Very Stiff Hard Friable	·	<2 25 50 10 20	CS (kPa) 25 5 - 50 0 - 100 00 - 200 00 - 400 400 pose	Moisture Condition D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TEST PIT NO:

NEW16P-0119

DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

TES	ST PI	IENT TYPE IT LENGTH	ł:	2.0 m	W	IDTH:	0.7 m DATUI Material description and profile information	ACE RL: M:			Fiel	d Test	
	اااات	iy anu sam	hiiiA			7	waterial description and profile information		I		1 161	u 1691	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics, colour, minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
		E 0.10m				SM	Silty SAND - fine to medium grained, grey-taffected.	prown, root	D - M				TOPSOIL
ш	Not Encountered	0.50m U50 0.75m		0.5		CH	Sandy CLAY - medium plasticity, orange-br red-brown and brown, fine grained sand. 1.40m Sandy CLAY / Clayey SAND - low to mediu plasticity, orange-brown to red-brown and g		M < w _p	Н	HP HP	>600	RESIDUAL SÕIL
				2.0_			grained sand. Hole Terminated at 1.60 m Very slow progress						
				2.5_ - - -									
Wate	Wat (Dat Wat Wat ta Cha	er Level e and time shi er Inflow er Outflow inges radational or	own)	Notes, San U ₅₀ CBR E ASS B Field Tests	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample f nmenta jar, se sulfate s c bag, a sample	ter tube sample for CBR testing I sample aled and chilled on site) Soil Sample air expelled, chilled)	S S F F St S VSt V	/ery Soft Soft Firm Stiff /ery Stiff Hard Friable V	V	25 50 10 20 >4	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15%
	tra — De	ansitional strate efinitive or distrata change		PID DCP(x-y) HP	Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)		L ME D VD) M D	oose lediun ense ery De	n Dense ense	Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



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TP13

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LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL: TEST PIT LENGTH: 2.0 m WIDTH: 0.7 m DATUM:

L	TES	ST P	T LENGTH	1 :	2.0 m	W	IDTH:	0.7 m DATU	VI:					
		Dril	ling and Sam	pling				Material description and profile information				Field	d Test	
	METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
			E (0.10m		_		SM	Clayey SAND - fine to medium grained, dar with fine to medium grained gravel, sub-ang silt, root affected.		М				TOPSOIL
		untered			_			Sandy CLAY - medium to high plasticity, di and orange-brown, fine grained sand.	ark grey	M ~ W	VSt	HP HP	300 350	RESIDUAL SOIL
		Not Encountered			0.5_		CH	0.80m Extremely Weathered SANDSTONE, break		M < W _P	Н	HP	500	EXTREMELY TO HIGHLY
00					1.0_			into Clayey SAND - fine to medium grained with some orange-brown, trace fine to med grained gravel (sandstone fragments), estin low to low strength. Hole Terminated at 0.90 m Practical Refusal	ium					WEATHERED ROCK
.003 Datgel Lab and In Situ To					1.5_									
< <drawingfile>> 09/09/2016 17:13 8.30.003 Datgel Lab and In Situ Tool</drawingfile>					2.0_ -									
					2.5_									
QT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ				1	-									
g NON-CORED BOREHOLE	Water Water Strat	wat Wat (Dat Wat	ter Level te and time sh ter Inflow ter Outflow	nown)	Notes, Sar U ₅₀ CBR E ASS	50mm Bulk s Enviro (Glass Acid S (Plasti	Diame ample f nmenta jar, se sulfate S	ter tube sample for CBR testing I sample aled and chilled on site) Soil Sample air expelled, chilled)	S S F F St S VSt V	recy Very Soft Soft Firm Stiff Very Stiff Hard Friable		<2 25 50 10 20	CS (kPa) 25 5 - 50 0 - 100 00 - 200 00 - 400	D Dry M Moist W Wet W _p Plastic Limit
QT LIB 1.1.GLB LO	<u> </u>	G tra De	radational or ansitional stra efinitive or distrata change	ta	Field Tests PID DCP(x-y) HP	Photoi Dynan	onisatio	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	Density	V L MC D VD	Lo M D	ery Lo oose lediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



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TP14

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LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL: **TEST PIT LENGTH:** 2.0 m WIDTH: 0.7 mDATUM: Drilling and Sampling Material description and profile information Field Test CLASSIFICATION SYMBOL CONSISTENCY DENSITY GRAPHIC LOG Structure and additional **Test Type** METHOD Result RL DEPTH MATERIAL DESCRIPTION: Soil type, plasticity/particle SAMPLES (m) (m) characteristics, colour, minor components TOPSOIL Silty SAND - fine to medium grained, grey-brown, root 0.10m SM RESIDUAL SOIL Sandy CLAY - medium plasticity, orange-brown, fine HP >600 grained sand. Not Encountered Ш HP >600 СН Н Σ HP 480 ΗP >600 1.0 HIGHLY WEATHERED М 1.05m SANDSTONE - fine to medium grained, brown and orange-brown, estimated medium to high strength. Hole Terminated at 1.05 m TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ <<DrawingFile>> 09/09/2016 17:13 8.30.003 Datgel Lab and In Situ Tool 1.5 2.0 2.5 LEGEND: Notes, Samples and Tests UCS (kPa) **Moisture Condition** Consistency Very Soft 50mm Diameter tube sample <25 Usc VS D Dry Water CBR Bulk sample for CBR testing S 25 - 50 Moist Soft M Water Level Ε Environmental sample F Firm 50 - 100 W Wet (Date and time shown) (Glass jar, sealed and chilled on site) Plastic Limit St Stiff 100 - 200 W. Water Inflow Acid Sulfate Soil Sample ASS VSt Very Stiff 200 - 400 Liquid Limit W, (Plastic bag, air expelled, chilled) Н ■ Water Outflow Hard >400 Strata Changes В **Bulk Sample** Fb Friable S_i Field Tests **Density** Very Loose Density Index <15% Gradational or QT LIB 1.1.GLB PID Photoionisation detector reading (ppm) Loose Density Index 15 - 35% transitional strata DCP(x-y) Dynamic penetrometer test (test depth interval shown) MD Medium Dense Density Index 35 - 65% Definitive or distict HP Hand Penetrometer test (UCS kPa) D Dense Density Index 65 - 85% strata change VD Very Dens Density Index 85 - 100%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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LOGGED BY: ΒE

		IENT TYPE: IT LENGTH		CAT - 2.0 m		NNE E	EXCAVATOR 0.7 m	SURFA DATUN	CE RL:					
	Dril	ling and Samp	oling				Material desc	ription and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DES characte	SCRIPTION: Soil type, plasticity ristics, colour, minor components	/particle s	MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		SM	affected.	fine to medium grained, grey-b	rown, root	D - M				TOPSOIL
Е	Not Encountered			- 0.5 		СН	grained sand	rey and orange-brown.	own, fine	M < w _P	Н			RESIDUAL SOIL
LEG	END:			- 2.5_ - -	mples an	d Tests	Very slow pr	ated at 2.10 m ogress	Consister	nev		U	CS (kPa)	Moisture Condition
<u>Wat</u>	er Wat (Dat Wat Wat	ter Level te and time sho ter Inflow ter Outflow ter Outflow ter adational or	own)	U ₅₀ CBR E ASS B Field Test:	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample nmenta jar, se sulfate s c bag, sample	eter tube sample for CBR testing al sample aled and chilled on si Soil Sample air expelled, chilled)		VS V S S F F St S VSt V	/ery Soft Soft Firm Stiff /ery Stiff Hard Friable V	V	<2 25 50 10 20 >4 ery Lc	25 5 - 50 0 - 100 00 - 200 00 - 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15%
	_ D	ansitional strata efinitive or disti rata change	1 1	PID DCP(x-y) HP	Dynan	nic pen	on detector reading (p etrometer test (test de ometer test (UCS kPa	epth interval shown)		L ME D VD) M D	oose lediun ense ery De	n Dense ense	Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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DATE: 9/8/16

Drilling and Sampling National description and profile information Plate Test Plate Test			IENT TYPE		CAT - 2.0 m		NNE E	EXCAVATOR 0.7 m	SURFA DATUN						
Structure and addition observations SAMPLES RL (m) DEPTH (m) Page 1 Sity SAND - fine to medium grained, grey-brown, root affected. SM Sandy CLAY - medium plasticity, dark grey and orange-brown. Sandy CLAY - medium plasticity, dark grey and orange-brown.						-							Field	d Test	
Becoming pale grey and orange-brown. CH Becoming pale grey and orange-brown. Signature Signat	METHOD	WATER	SAMPLES		DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL				MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Sandy CLAY - medium plasticity, dark grey and orange-brown, fine grained sand. USO					-	***************************************	SM	affected.	fine to medium grained, grey-b	rown, root	D - M				TOPSOIL
Hole Terminated at 2.00 m Very slow progress Hole Terminated at 2.00 m Very slow progress LEGEND: Water Water Level (Date and time shown) Water Inflow Water Inflow Water Inflow Water Outflow Water Couflow Water Couflow (Glass jar, sealed and chilled on site) ASS Acid Sulfate Soil Sample (Plastic bag, air expelled, chilled) Water Outflow Water Inflow Water Outflow Water Inflow Water Outflow Water Outflo		Not Encountered	U50		1.0 - - 1.5 -		СН	Sandy CLAY orange-brown	n, fine grained sand.	and	M < w _p	Н			RESIDUAL SOIL
Strata Changes Gradational or transitional strata Definitive or district Definitive or district Definitive or district Reference of the content of the	GLB Log NON-CORED BOREHOLE - TEST PIT NEW16P-0119 - TEST PIT LOGS, GPJ < <ur> ATT ATT</ur>	tter Wa (Da — Wa ■ Wa tata Cha	te and time sl ter Inflow ter Outflow anges radational or	hown)	- 2.5 - 2.5 	50mm Bulk s Enviro (Glass Acid s (Plast Bulk s	n Diame sample s onmenta s jar, se Sulfate s ic bag, s Sample	Hole Termina Very slow pro ter tube sample for CBR testing al sample aled and chilled on sit Soil Sample air expelled, chilled) on detector reading (p	pgress te)	VS V S S F Fi St S VSt V H H Fb Fi	ery Soft oft irm tiff ery Stiff ard riable V L	Lo	25 50 10 20 >4 ery Lo	25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit



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LOCATION: CESSNOCK CORRECTIONAL CENTRE DA

ENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

			IENT TYPE		CAT - 2.0 m		NNE E	EXCAVATOR 0.7 m	SURF <i>A</i> DATUM	ACE RL:					
r		Drill	ling and San	npling				Material descri	ption and profile information				Fiel	d Test	
	METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		CRIPTION: Soil type, plasticity istics,colour,minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
			E (0.10m		-		SM	Silty SAND - f affected.	îne to medium grained, grey-b	rown, root	D - M				TOPSOIL
			0.45m		-		CI		- medium plasticity, red-brown and grey, with fine to medium unded.				HP	>600	RESIDUAL SOIL 7 POSSIBLE FILL
	ш	Not Encountered	E 19:55M ✓		0. <u>5</u> -				- low to medium plasticity, and pale grey, with some red and.	 -brown,	√ _P		HP	>600	RESIDUAL SOIL
		ž	U50 1.00m		1.0_		CL		eathered SANDSTONE, break		M < Wp	Н			EXTREMELY WEATHERED
Situ Tool					-			yellow-brown	AND - fine to medium grained, with some pale grey, trace fine tone fragments), estimated ve	e grained					ROCK
QTLIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ < <drawingfile>> 09/09/2016 17:13 8:30.003 Datyel Lab and In Situ Tool</drawingfile>					1.5_ - -			Hole Terminat Very slow pro							
DrawingFile>> 09/09/2016 17					2.0_ -										
0119 - TEST PIT LOGS.GPJ <<					- 2.5_ -										
HOLE - TEST PIT NEW16P-	LEGI				Notes, Sar			: ter tube sample		Consister VS V	ncy /ery Soft			CS (kPa	Moisture Condition D Dry
Log NON-CORED BORE	Wate	Wat (Dat Wat Wat a Cha		1	CBR E ASS B	Bulk s Enviro (Glass Acid s (Plast Bulk s	ample f nmenta jar, se Sulfate S	ter tube sample for CBR testing I sample aled and chilled on site Soil Sample air expelled, chilled)	2)	S S F F St S VSt V H F	Soft Firm Stiff /ery Stiff lard Friable V		25 50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400	M Moist W Wet W _p Plastic Limit
QT LIB 1.1.GLB		tra — De	radational or ansitional stra efinitive or dis rata change		PID DCP(x-y) HP	Photo Dynar	nic pen	on detector reading (pp etrometer test (test dep meter test (UCS kPa)		<u>Density</u>	V L MD D VD	Lo M D	oose	n Dense	Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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		MENT TYPE		CAT - 2.0 m		NNE E	EXCAVATOR 0.7 m	SURFACE RL DATUM:	.:				
Ë		lling and Sam		2.0111			Material description and pro				Fie	ld Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: S characteristics, colour, r	oil type, plasticity/particle	MOISTURE	CONDITION		Result	Structure and additional observations
		0.10m 0.30m		-		SM	Silty SAND - fine to mediur o_10m medium grained gravel, roo Sandy CLAY - medium to h and orange-brown, fine gra	ot <u>affected.</u> nigh plasticity, grey-browr			HP	>600	TOPSOIL RESIDUAL SOIL / POSSIBLE FILL
	tered	0.40m 0.50m 0.60m		- 0. <u>5</u> -			Sandy CLAY - low to med orange-brown and pale gre fine grained sand.				HP		RESIDUAL SOIL
03 Datgel Lab and in Situ Tool	Not Encountered	(0.80m (0.90m		- 1.0_ - - - 1.5_		CL	Becoming pale orange and	pale grey.		«» N IM ⊢			
OT LIB 1.1.GLB Log NON-CORED BOREHOLE - TEST PIT NEW18P-0119 - TEST PIT LOGS.GPJ. <-DrawingFile>> 09/09/2016 17:13 8.30.003 Datge Lab and In Situ Tool Report Tools (GPJ. Control of Contro				2.0 <u></u>			Extremely Weathered SAN into Clayey SAND - fine to yellow-brown with some payravel (sandstone fragmen low strength. Hole Terminated at 1.80 m Practical Refusal	medium grained, lle grey, trace fine grained ts), estimated very low to	a /	M			EXTREMELY TO HIGHLY WEATHERED ROCK
T LIB 1.1.GLB Log NON-CORED BOREHOLE -	. Wa (Da - Wa ■ Wa ata Ch - tr	ter Level te and time sh ter Inflow ter Outflow anges irradational or ansitional stra efinitive or dist irrata change	iown)	B Field Test: PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid s (Plast Bulk s S Photo Dynar	n Diame ample ample anmenta s jar, se Sulfate s ic bag, Sample ionisati nic pen	ter tube sample for CBR testing Il sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval sho	VS S F St VSt H Fb	Very Soft Firm Stiff Very Hard Friab	Stiff	2 5 1 2 > Very L	m Dense	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

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DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

	Dril	ling and Samp	oling				Material description and profile in	nformation			Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil ty characteristics,colour,mino		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E			} }	ರ SM	FILL: Silty SAND - fine to medi	um grained,	M	0			TOPSOIL
	red	(0.10m					0.10m grey-brown, root affected. FILL: Sandy CLAY - medium pl and orange-brown.	asticity, red-brown			HP	280	RESIDUAL SOIL / POSSIB FILL
ш	Not Encountered			0.5_		CI			W	VSt	HP	280	
							0.70m				ļ'"	010	RESIDUAL SOIL
						CL	Sandy CLAY / Clayey SAND - plasticity, orange-brown and gr	ey, fine grained sand.	M ~ W	н	HP	480	
				1.0	<u>:::::</u>		SANDSTONE, breaks down int to medium grained, yellow-brow grey, with fine to medium grained	vn with some pale	M				EXTREMELY TO HIGHLY WEATHERED ROCK
				2.0			fragments), estimated very low Hole Terminated at 1.00 m Refusal						
Wat	Wat (Dat Wat	ter Level te and time sho	own)	Notes, San U₅ CBR E ASS	50mm Bulk s Enviro (Glass Acid S	Diame ample t nmenta jar, se Sulfate S	ter tube sample or CBR testing I sample aled and chilled on site) Soil Sample	S S F St St S	Very Soft Soft Firm Stiff Very Stiff		<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400	D Dry M Moist W Wet W _p Plastic Limit
Stra	ta Cha G tra De	er Outflow Inges radational or ansitional strata efinitive or disti rata change	a	B Field Tests PID DCP(x-y) HP	Bulk S Photoi Dynan	Sample ionisationic pen	on detector reading (ppm) entrometer test (test depth interval shown) meter test (UCS kPa)	Fb Density	Hard Friable V L MI D VC	L) M	ery Lo	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



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LOCATION: CESSNOCK CORRECTIONAL CENTRE **DATE:** 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:
TEST PIT LENGTH: 2.0 m WIDTH: 0.7 m DATUM:

Т	ES1	ΓPI	T LENGTI	H:	2.0 m	W	IDTH:	0.7 m DATUM	Л:					
		Drill	ing and Sam	npling				Material description and profile information				Field	d Test	
METHOD		WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics, colour, minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
			E 0.10m		_		SM	Silty SAND - fine to medium grained, grey-baffected.	rown, root	М				TOPSOIL
			0.50m		- 0.5_			Sandy CLAY - medium plasticity, orange-br dark grey, fine grained sand.	own and			HP HP	500 550	RESIDUAL SOIL
ш	· .	Not Encountered	U50 0.75m		-					_م		HP	500	
100	:	N			1.0 -		CI			M < Wp	Н	HP	480	
Lab and In Situ To					1.5			1.45m SANDSTONE - fine to coarse grained, oran to brown and grey, estimated low to mediun		M				HIGHLY WEATHERED /
- <drawingfile>> 09/09/2016 17:13 8.30.003 Datgel Lab and In Situ Tool</drawingfile>					- - 2.0_			Hole Terminated at 1.50 m Practical Refusal						
OT LIB 11.1GLB LOG NON-CORED BOREHOLE - TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ < <draw iss="" th="" v<="" =""><td></td><td></td><td></td><td></td><td>- 2.5_ -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></draw >					- 2.5_ -									
OREHOLE - TEST PIT NEI	EGEN		er Level		Notes, Sar	50mm Bulk s	Diame	ter tube sample or CBR testing	S S	ery Soft		<2 25	5 - 50	D Dry M Moist
B Log NON-CORED B	- - '	(Date Wate Wate Cha	e and time sh er Inflow er Outflow nges		E ASS B Field Tests	(Glass Acid S (Plast Bulk S	i jar, se Sulfate S ic bag, a Sample	l sample aled and chilled on site) Soil Sample air expelled, chilled)	St S VSt V H H	irm Stiff Yery Stiff Hard Friable V		10 20 >4 ery Lo	0 - 100 00 - 200 00 - 400 400 pose	W _L Liquid Limit Density Index <15%
QT LIB 1.1.GLI	Gradational or transitional strata Definitive or distict strata change				PID DCP(x-y) HP	Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)		L MD D VD) M D	oose ediun ense ery De	n Dense	Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LEND LEASE

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LOGGED BY:

TEST PIT NO:

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LOCATION: CESSNOCK CORRECTIONAL CENTRE DATE: 9/8/16

		IENT TYPE T LENGTH		CAT - 2.0 m		NNE E I dth :	EXCAVATOR 0.7 m	SURFA DATUM						
	Dril	ling and Sam	pling				Material description	and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		ΠΟΝ: Soil type, plasticity/ colour,minor components		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		_		SM	affected.	medium grained, grey-br	rown, root	D - M				TOPSOIL
				_			Sandy CLAY - med dark grey, fine grain	ium plasticity, orange-bro ned sand.	wn and			HP	>600	RESIDUAL SOIL
	untered	0.50m U50 0.68m		0.5_								HP	>600	
Ш	Not Encountered			1.0_		CI	Becoming red-brow	n to orange-brown and pa	ale grey.	M < W	н	HP	>600	
				1.5_			1.60m Hole Terminated at	160 m						
				_			Very slow progress							
				2.0										
				_										
				2.5										
				-										
LEG Wat	END:			Notes, San			i ter tube sample		Consiste VS \	ncy /ery Soft			CS (kPa)	Moisture Condition D Dry
¥	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow	own)	CBR E ASS	Bulk s Enviro (Glass Acid S (Plasti	ample nmenta jar, se sulfate s	for CBR testing il sample aled and chilled on site) Soil Sample air expelled, chilled)		S S F F St S VSt \ H H	Soft Firm Stiff /ery Stiff Hard Friable		25 50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400	M Moist W Wet W _p Plastic Limit
<u> </u>	tra Do	radational or ansitional strate efinitive or distrata rata change		PID DCP(x-y) HP	Photoi Dynan	onisati	on detector reading (ppm) etrometer test (test depth intermeter test (UCS kPa)	erval shown)	<u>Density</u>	V L ME D	Lo D D	ery Lo oose lediun ense ery Do	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



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LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE **DATE:** 9/8/16

 EQUIPMENT TYPE:
 CAT - 14 TONNE EXCAVATOR
 SURFACE RL:

 TEST PIT LENGTH:
 2.0 m
 WIDTH:
 0.7 m
 DATUM:

		MENT TYPE PIT LENGTI		2.0 m		IDTH:		ACE RL: M:					
	Dri	lling and San	npling				Material description and profile information				Field	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticil characteristics,colour,minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
	Not Encountered	0.30m 0.50m 0.60m U50 0.80m		- - 0.5_ -		CI	Silty SAND - fine to medium grained, grey-affected. Sandy CLAY - medium plasticity, orange-b red-brown, fine grained sand.	rown and	D - M	Н			TOPSOIL RESIDUAL SOIL HIGHLY WEATHERED
				- 1.0_ - -			pale grey, estimated medium to high streng Hole Terminated at 0.83 m Refusal						ROCK
7:13 8:30.003 Datgel Lab and in Situ Tool				- 1. <u>5</u> - -									
OGS.GPJ < <drawingfile>> 09/09/2016 1</drawingfile>				2.0_ - - -									
- TEST PIT NEW16P-0119 - TEST PITL				2.5_ - - - -									
NON-CORED BOREHOI	Va (Da - Wa ■ Wa ata Cha	ater Level ate and time sl ater Inflow ater Outflow anges Gradational or ransitional stra	hown)	Notes, Sar U ₅₀ CBR E ASS B Field Test: PID DCP(x-y)	50mm Bulk s Enviro (Glass Acid S (Plast Bulk S	Diame ample from the signature of the si	ter tube sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown)	S S F F St S VSt V H H	ery Soft oft irm tiff ery Stiff ard riable V L ME	Lo	<2 25 50 10 20 >4 ery Lo	5 - 50 0 - 100 00 - 200 00 - 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%
QT LIB 1		efinitive or dis trata change	suct	HP	-		ometer test (UCS kPa)		D VD	D	ense ery De		Density Index 65 - 85% Density Index 85 - 100%



LEND LEASE

PROJECT: PROPOSED EXPANSION

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LOGGED BY: BE

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR

SURFACE RL: **TEST PIT LENGTH:** 2.0 m WIDTH: 0.7 mDATUM: Drilling and Sampling Material description and profile information Field Test CLASSIFICATION SYMBOL CONSISTENCY DENSITY MOISTURE CONDITION GRAPHIC LOG Structure and additional **Test Type** METHOD Result RL DEPTH MATERIAL DESCRIPTION: Soil type, plasticity/particle SAMPLES (m) (m) characteristics, colour, minor components TOPSOIL Silty SAND - fine to medium grained, grey-brown, root SM 0.10m RESIDUAL SOIL Sandy CLAY - medium plasticity, red-brown with Not Encountered some orange-brown and grey, fine grained sand. 0.40m ш CI Σ В U50 0.70m EXTREMELY TO HIGHLY SANDSTONE - fine to medium grained, orange-brown and pale grey, estimated low strength. М WEATHERED ROCK Hole Terminated at 0.80 m Refusal 1.0 TEST PIT NEW16P-0119 - TEST PIT LOGS.GPJ <<DrawingFile>> 09/09/2016 17:13 8.30.003 Datgel Lab and In Situ Tool 1.5 2.0 2.5 LEGEND: Notes, Samples and Tests UCS (kPa) **Moisture Condition** Consistency Very Soft 50mm Diameter tube sample <25 Usc VS D Dry Water CBR Bulk sample for CBR testing S 25 - 50 Moist Soft M Water Level Ε Environmental sample F Firm 50 - 100 W Wet (Date and time shown) (Glass jar, sealed and chilled on site) Plastic Limit St Stiff 100 - 200W. Water Inflow Acid Sulfate Soil Sample Very Stiff ASS 200 - 400 Liquid Limit VSt W, (Plastic bag, air expelled, chilled) Н ■ Water Outflow Hard >400 Strata Changes В **Bulk Sample** Fb Friable S_i Field Tests **Density** Very Loose Density Index <15% Gradational or QT LIB 1.1.GLB PID Photoionisation detector reading (ppm) Loose Density Index 15 - 35% transitional strata DCP(x-y) Dynamic penetrometer test (test depth interval shown) MD Medium Dense Density Index 35 - 65% Definitive or distict HP Hand Penetrometer test (UCS kPa) D Dense Density Index 65 - 85% strata change VD Very Dens Density Index 85 - 100%



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LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE **DATE:** 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:
TEST PIT LENGTH: 2.0 m WIDTH: 0.7 m DATUM:

		T LENGTH		2.0 m		IDTH:	0.7 m DATU Material description and profile information				Fiel	d Test	
МЕТНОБ	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plastici characteristics,colour,minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
				-		SM	Sandy SILT - low plasticity, fine to medium grey-brown, trace fine to medium gravel, su to sub-angular, root affected.	grained, ub-rounded	D - M				TOPSOIL
				-			Sandy CLAY - medium plasticity, red-brow some orange-brown and grey, fine grained	— — — — · n with sand.			HP	>600	RESIDUAL SOIL
	ntered			0.5_							HP	>600	
П	Not Encountered			-		CI			M < W _P	н	HP	>600	
				1.0_									
				-			1.40m SANDSTONE - fine to medium grained, ora		М				HIGHLY WEATHERED ROCK
				1.5			1.50m and pale grey, estimated low to medium st Hole Terminated at 1.50 m Refusal	rengtn.					TOOK
				_									
				2.0_									
				_									
				2.5_									
				-									
_EG	END:			Notes, San	50mm	Diame	ter tube sample		ery Soft		<2	CS (kPa 25	D Dry
<u>*</u>	Wat (Dat Wat Wat	er Level e and time sho er Inflow er Outflow	own)	CBR E ASS B	Enviro (Glass Acid S (Plasti	nmenta jar, se Sulfate S	for CBR testing all sample aled and chilled on site) Soil Sample air expelled, chilled)	F F St S VSt V H H	oft irm stiff ery Stiff lard riable		50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400	P P
otra	tra — De	i nges radational or ansitional strata efinitive or disti rata change	a	Field Tests PID DCP(x-y) HP	S Photoi Dynan	ionisationic pen	on detector reading (ppm) etrometer test (test depth interval shown) emeter test (UCS kPa)	<u>Density</u>	V L ME	Lo M	ery Lo oose lediun ense	oose n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85%



CLIENT: LEND LEASE

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LOGGED BY:

DATE: 9/8/16

EQUIPMENT TYPE: CAT - 14 TONNE EXCAVATOR SURFACE RL:

		IENT TYPE T LENGTI		2.0 m		NNE E		URFACE RL: ATUM:					
	Drill	ing and Sam	npling				Material description and profile informa	ation			Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, p characteristics,colour,minor com		MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m		-		SM	Silty SAND - fine to medium grained, fine to medium grained gravel, sub-ro sub-angular, root affected.	grey-brown, with ounded to	М				TOPSOIL
Е	Not Encountered	0.30m B 0.50m		0.5_		CI	Sandy CLAY - medium plasticity, red some orange-brown, fine grained sar	-brown with id.	M < W _P	Н	HP HP	>600 >600	RESIDUAL SÕIL
				1.0			SANDSTONE - fine to medium graine and pale grey, estimated medium str Hole Terminated at 1.10 m		М				HIGHLY WEATHERED ROCK
				1.5			Refusal						
	END:				nples an			Consisten	-			CS (kPa	
Water Strain	Wat (Dat Wat Wat ta Cha Gi tra	er Level e and time sher Inflow er Outflow inges radational or ansitional stra efinitive or dis rata change	nown)	U ₅₀ CBR E ASS B Field Tests PID DCP(x-y) HP	Bulk s Enviro (Glass Acid S (Plasti Bulk S Photoi Dynan	ample inmentation jar, se julfate \$ c bag, ample onisation pending pen	ter tube sample or CBR testing I sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	S So F Fi St St VSt Vo H Ha	ery Soft oft rm tiff ery Stiff ard riable V L ME D VD	V L(25 50 10 20 >4 ery Lo	n Dense	Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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NEW16P-0119

TP26

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9/8/16

LOGGED BY: BE

		IENT TYPE IT LENGTH		CAT - 2.0 m		NNE E I DTH :		FACE RL: JM:					
	Dril	ling and Sam	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plastic characteristics,colour,minor compone		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E				SM	Silty SAND - fine to medium grained, grey	-brown, root					TOPSOIL
		(0.10m		-	/ /	sc	Clayey SAND - fine to medium grained, g fine to medium grained, gravel, sub-round	rey, with led.	М	MD			SLOPE WASH
				0. <u>5</u>			Sandy CLAY - medium to high plasticity, and orange, fine grained sand.	grey-brown	M × W	VSt	HP HP	280 300 360	RESIDUAL SOIL
.003 Dagger Lab and in Situ 1 ool	Not Encountered	0.60m B 0.90m		- 1.0_ - - 1.5_		CI	Becoming red-brown with some grey.		M < Wp - M ~ Wp	н	HP HP HP	580 580 >600	
GILBT.1.SEB LOG NON-CORED BOXEHOLE: TEST PIT NEWNOR-UTHS-TEST PIT LOGS.GPO. CDRWINGFIRS> US/US/CDRG T/7:3 8.30.003 Dagget Lab and in Situ Tool 100 Test PIT LOGS.GPO.				2.0 - - - 2.5 -			1.75m SANDSTONE - fine to medium grained, or to red-brown and grey, estimated low streymedium strength. Hole Terminated at 1.80 m Refusal		M				EXTREMELY TO HIGHLY WEATHERED ROCK
Wat Wat Stra	Wai (Dai Wai I Wai ta Cha tra — G	ter Level te and time sh ter Inflow ter Outflow ter Outflow ter adational or ansitional stratefinitive or distrata change	nown)	Notes, Sar Uss CBR E ASS B Field Tests PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid S (Plast Bulk S Photo Dynar	Diame ample nmenta jar, se Gulfate c bag, sample donisati nic pen	eter tube sample for CBR testing al sample ealed and chilled on site) Soil Sample air expelled, chilled)	S S F F St S VSt \	ncy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L MC D VD	V L	25 50 10 20 >4 /ery Lo	n Dense	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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LOGGED BY: SJK

DATE: 25/8/16

		IENT TYPE		5 TON 3.0 m		CAVA DTH:		ACE RL:					
		ling and Sam		0.0 111			Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticil characteristics, colour, minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
	Not Encountered	E 0.10m 0.20m CBR U50 0.50m		- - 0.5_		SM	Silty SAND - fine to coarse grained, brown fines of low plasticity, root affected. CLAY - medium to high plasticity, pale brow fine to medium grained sand.		M ~ W		HP	450	TOPSOIL RESIDUAL SOIL
В	Not Enc	1.00m D 1.10m		1.0_			Extremely weathered Silty SANDSTONE w properties, breaks down into Sandy Clayey - fine to coarse grained, angular, pale grey to grey, fines of medium plasticity, some hi weathered pockets.	GRAVEL and brown	M	Н	HP	>600	EXTREMELY WEATHERED ROCK
				1.5_			Silty SANDSTONE - fine to medium grained 1.40m brown and brown to grey, estimated low stream Hole Terminated at 1.40 m Practical Refusal		D				HIGHLY WEATHERED ROCK
				- - 2.5_									
Wate	Wat (Dat Wat	ter Level te and time sho ter Inflow ter Outflow ter Outflow	own)	- Notes, Sar U _∞ CCBR E ASS	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample nmenta jar, se julfate s c bag,	eter tube sample for CBR testing al aled and chilled on site) Soil Sample air expelled, chilled)	S S S S S S S S S S S S S S S S S S S	/ery Soft Soft Firm Stiff /ery Stiff Hard		50 50 10 20 >4	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit
	tra — De	radational or ansitional strati efinitive or disti rata change	a	Field Tests PID DCP(x-y) HP	Photoi Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)	<u>Density</u>	V L ME D VD	Lo D D	ery Lo pose lediun ense ery Do	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP28

SJK

LOGGED BY:

DATE: 25/8/16

EQUIPMENT TYPE: 5 TONNE EXCAVATOR SURFACE RL:

		IENT TYPE		5 TON				SURFACE RL:					
		IT LENGTH		3.0 m	VV	IDTH:	0.5 m	DATUM:			F: 1		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	Material description and profile MATERIAL DESCRIPTION: Soil characteristics, colour, min	type, plasticity/particle	MOISTURE	CONSISTENCY DENSITY	Test Type	Result Result	Structure and additional observations
		E ,0.10m		_		SM	Silty Gravelly SAND - fine to c pale brown, fine to medium gr 0.15m gravel, fines of low plasticity,	ained sub-rounded	M				TOPSOIL
				- 0.5_ -		СН	CLAY - medium to high plasticity, i CLAY - medium to high plastic some brown to red and grey, grained sand.	city, pale brown, with	M > W _P	VSt	HP HP	270	RESIDUAL SÕIL
Ш	Not Encountered	1.20m		1.0_ -			1.10m Sandy CLAY - medium to high and pale grey, with some brow				HP HP	450	
<culawiig-lie>> valoa/Zulo 17:13 6.30.003 Daggel Lab and In Silu Tool</culawiig-lie>		D 1.50m		- 1.5_ - - - - 2.0		СН	Some highly weathered pocke	ts.	M ~ w _p	н			
				2.0_			0.40						
				2.5_ -			SANDSTONE - fine to coarse SANDSTONE - fine to coarse brown to orange and pale grey medium strength. Hole Terminated at 2.15 m Refusal		D - M				HIGHLY WEATHERED ROCK
Wat Wat	Wat (Dat - Wat Wat - G tra	ter Level te and time shi ter Inflow ter Outflow anges ansitional or ansitional strat efinitive or dist rata change	own)	Notes, Sar U _{ss} CBR E ASS B Field Test PID DCP(x-y) HP	50mm Bulk s Enviro (Glass Acid s (Plast Bulk s S Photo Dynar	Diame ample finmenta sign, sea Sulfate Sic bag, a sample sonisationic peneral	ter tube sample or CBR testing sample sled and chilled on site) oil Sample iir expelled, chilled) in detector reading (ppm) strometer test (test depth interval showr meter test (UCS kPa)	S S F F St S VSt V H F Fb F Density	ncy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L ME	V L	25 50 10 20 20 ery Lo	n Dense	D Dry M Moist W Wet W _p Plastic Limit U _t Liquid Limit Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

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LOGGED BY: SJK

LOCATION: CESSNOCK CORRECTIONAL CENTRE

		IENT TYPE		5 TON 3.0 m		CAVA	TOR SURFA 0.5 m DATUI	ACE RL:					
	Dri	ling and Sam	pling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics, colour, minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E 0.10m		-		SM	Silty SAND - fine to coarse grained, brown fines of low plasticity, root affected. Silty Gravelly SAND - fine to coarse grained	 d, pale	- D				TOPSOIL SLOPE WASH
		0.30m		-			Description of the state of				HP	>600	RESIDUAL SOIL
	tered	0.50m		0.5_			Becoming brown to red, pale brown and gre	ey.			HP	>600	
ш	Not Encountered			-		СН			M < W _P	Н			
				1.0 -							HP	>600	
tgel Lab and In Situ Tool				1.5	///// :::::		SANDSTONE - fine to coarse grained, pale Som brown to orange and brown to red, estimate medium strength. Hole Terminated at 1.50 m	grey, pale ed low to	D				HIGHLY WEATHERED ROCK
rawingFile>> 09/09/2016 17:13 8.30.003 Da				2.0			Practical Refusal						
V16P-0119 - TEST PTL LOGS.GPJ << Dr				- 2.5_ -									
MON-CORED BOREHO	Wa (Da	ter Level te and time sh ter Inflow ter Outflow anges	own)	Notes, San U ₅₀ CBR E ASS	50mm Bulk s Enviro (Glass Acid S (Plasti	Diame ample f nmenta jar, se sulfate S	ter tube sample or CBR testing I sample alled and chilled on site) ioil Sample air expelled, chilled)	S S F F St S VSt V	ncy /ery Soft Soft Stiff /ery Stiff Hard		<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit
OT LIB 1.1.GLB L	G tr D	radational or ansitional strat efinitive or dist rata change	a	Field Tests PID DCP(x-y) HP	Photoi Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	<u>Density</u>	V L ME D VD	Lo M D	ery Lo oose ediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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TP30

LOGGED BY: SJK

DATE: 25/8/16

		MENT TYPE:		5 TON 3.0 m		CAVA DTH:		SURFACE RL: DATUM:					
		ling and Samp		3.0 111	***	D 111.	Material description and profile inform				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, characteristics, colour, minor co	plasticity/particle	MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
3	Not Encountered	E 0.10m 0.20m 0.30		0.5		SM SM	FILL: Sitty SAND - fine to coarse grey, fines of low plasticity, trace fit grained sub-angular gravel, root aff. 0.20m Sitty SAND - mostly fine to medium brown, fines of low plasticity. CLAY - medium to high plasticity, be pale brown, some fine to coarse grain brown to orange and brown to red, medium strength. 1.15m SANDSTONE - fine to coarse grain brown to orange and brown to red, medium strength. 10 scrapes for 50mm with toothed the Terminated at 1.15 m Practical Refusal	e to coarse excted	M M M M	VSt	HP HP	250 300 >600	FILL - TOPSOIL SLOPE WASH RESIDUAL SOIL HIGHLY WEATHERED ROCK
Wat	Wat (Dat Wat Wat I Wat I G G tra	ter Level te and time sho ter Inflow ter Outflow	own) A	U ₅₀ CBR E ASS B Field Tests PID CCP(x-y) HP	50mm Bulk si Enviro (Glassi Acid Si (Plasti Bulk Si Photoi Dynam	Diame ample inmenta jar, se ulfate \$ c bag, ample onisationic peni	ter tube sample or CBR testing I sample aled and chilled on site) soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa)	S S S S S S S S S S S S S S S S S S S	very Soft Soft Firm Stiff Hard Friable V L MI D V	V L(25 50 10 20 >4 ery Lo	n Dense	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



LEND LEASE

PROJECT: PROPOSED EXPANSION

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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LOGGED BY: SJK

DATE: 25/8/16

		IENT TYPE IT LENGTH		5 TON 3.0 m		CAVA I DTH :		RFACE RL: TUM:					
		ling and Sam		0.0			Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plas characteristics,colour,minor compo	ticity/particle	MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
		E (0.10m				GM	FILL: Sitty Sandy GRAVEL - fine to coa grey to brown, fine to coarse grained so 0.15m low plasticity, some grass roots.	rse grained, nd, fines of	М				FILL - ACCESS TRACK EDGE
Е	Not Encountered	0.30m U50 0.60m		0.5		СН	CLAY - medium to high plasticity, pale fine to coarse grained sand.	prown, some	M > W _P	VSt - H	HP HP	400 430 410	RESIDUAL SOIL
				1.5			Becoming extremely weathered Sandst 1.60m SANDSTONE - fine to coarse grained, orange, pale grey and grey to brown, e medium strength.	 pale brown to		н	HP	550	HIGHLY WEATHERED ROCK
				2.0_			1.80m 10 scrapes for 90mm with toothed excall Hole Terminated at 1.80 m Practical Refusal	out bucket.					
Wate	Wat (Dat Wat Wat La Cha Tra	ter Level te and time she ter Inflow ter Outflow anges radational or ansitional strat efinitive or dist	own)	Notes, San U ₅₀ CBR E ASS B Field Tests PID DCP(x-y)	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample nmenta gar, se Sulfate ic bag, sample	ter tube sample for CBR testing il sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown)	Consist VS S F St VSt H Fb Density	Very Soft Soft Firm Stiff Very Stiff Hard Friable	V	25 50 10 20 22 ery Lo	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400 pose	D Dry M Moist W Wet W _p Plastic Limit Liquid Limit Density Index <15% Density Index 15 - 35%



CLIENT: LEND LEASE

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TP32

25/8/16

LOGGED BY: SJK

LOCATION: CESSNOCK CORRECTIONAL CENTRE

EQUIPMENT TYPE: 5 TONNE EXCAVATOR SURFACE RL:

TEST PIT LENGTH: 1.2 m WIDTH: 0.5 m

	Dril	ling and Sam	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
ш	Not Encountered	E (0.10m		_		SM	FILL: Silty SAND - fine to medium grained, brown, trace brick and glass fragments, roo	ot affected.	M				FILL - TOPSOIL
	Not E			ļ		СН	CLAY - medium to high plasticity, pale brown fine to coarse grained sand.	vn, some	× ≥				RESIDUAL SOIL
				-			Hole Terminated at 0.30 m						
				0.5_									
				-									
				-									
				-									
				-									
				1.0_									
				-									
				1.5_									
				-									
				-									
				-									
				-									
				2.0_									
				-									
				_									
				2.5_									
				-									
				-									
				-									
				-									
	END:	1		Notes, Sar	-		i ter tube sample	Consiste VS \	ncy Very Soft			 CS (kPa) 25	Moisture Condition D Dry
Wate		ter Level		O ₅₀ CBR E	Bulk s	ample 1	for CBR testing il sample	s s	very son Soft Firm		25	25 5 - 50 0 - 100	M Moist W Wet
_	•	te and time sh ter Inflow	- 1	ASS	(Glass	jar, se	aled and chilled on site) Soil Sample	St S	-iiiii Stiff Very Stiff		10	00 - 100 00 - 200 00 - 400	W _p Plastic Limit
-	l Wat	ter Outflow		В	(Plasti		air expelled, chilled)	н	very Still Hard Friable			400	Liquid Linin
		radational or		Field Tests	<u>s</u>		on detector reading (ppm)	Density	V L		ery Lo	oose	Density Index <15% Density Index 15 - 35%
	_ D	efinitive or dis		DCP(x-y) HP	Dynan	nic pen	etrometer test (test depth interval shown) meter test (UCS kPa)		ME D) M		n Dense	
	st	rata change	[<u>.</u>	inaliu	- eneuc	ווויטנטו נכסנ (טטט מו מ)		VE		ense ery De	ense	Density Index 85 - 85% Density Index 85 - 100%



LEND LEASE

PROJECT: PROPOSED EXPANSION

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SJK

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TP33

LOCATION: CESSNOCK CORRECTIONAL CENTRE

		IENT TYPE		5 TON 3.0 m		CAVA DTH :		ACE RL:					
		ling and Sam		2.0 111			Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plastic characteristics,colour,minor compone		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
	untered	0.10m 0.30m U50 0.60m		0.5_		SM	Silty SAND - mostly fine to medium graine brown, fines of low plasticity, root affected CLAY - medium to high plasticity, brown to pale brown, some fine to medium sand.		M v M	Н	HP	550 >600	TOPSOIL RESIDUAL SOIL
Е	Not Encountered	0.90m D (1.00m		- - 1.0_		 GC	Extremely weatthered SANDSTONE with a properties, breaks down into Sandy Clayerine to coarse grained, angular, pale brougrey and brown to grey, fines of medium pasome highly weathered pockets.	y GRAVEL vn, pale lasticity,	М		HP	>600	EXTREMELY WEATHERED ROCK
				-			Silty SANDSTONE - mostly fine to mediur grey to brown, pale brown to orange and p white, estimated low to medium strength. 1.40m Hole Terminated at 1.40 m		D - M				HIGHLY WEATHERED ROCK
				1.5_ - - - 2.0_			Slow progress						
				- - - 2.5_									
I EC	END:		T :	- - - Notes, Sar	nnlae an	d Toeto		Concicto	ncv		110	CS (kPa	a) Moisture Condition
<u>Wate</u>	er Wat (Dat Wat Wat	ter Level te and time she ter Inflow ter Outflow unges radational or	own)	U ₅₀ CBR E ASS B Field Tests	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample f nmenta jar, se ulfate s c bag, a ample	ter tube sample for CBR testing al sample also and chilled on site) Soil Sample air expelled, chilled)	S S F F St S VSt \	Very Soft Soft Firm Stiff Very Stiff Hard Friable V	V	28 50 10 20 20 20	25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15%
_	tra — D	ansitional strat efinitive or dist rata change	1 1	PID DCP(x-y) HP	Dynan	nic pen	on detector reading (ppm) etrometer test (test depth interval shown) imeter test (UCS kPa)		L MD D VD) M D	oose lediun ense ery De	n Dense ense	Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



ENGINEERING LOG - BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

CLIENT: LEND LEASE

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BOREHOLE NO:

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BH01

LOGGED BY: BE

DATE: 4-8-16

 DRILL TYPE:
 TRUCK MOUNTED RIG
 SURFACE RL:

 BOREHOLE DIAMETER:
 100/50 mm
 DATUM:

	Dril	ling and Sam	pling				DATUI Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics, colour, minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Observed	0.50m SPT 5, 11, 16 N* = 27 D 0.95m		1.6 2.0 2.5		SP	Gravelly SAND - fine to coarse grained, bromedium grained gravel, sub-angular, with c Sandy CLAY - medium to high plasticity, re and orange-brown, fine to medium grained Extremely weathered SANDSTONE, excave Sandy CLAY / Clayey SAND - fine to mediugrained, pale brown. Becoming brown. Becoming pale brown.	d-brown sand.	M N N	Н	HP	>600	SLOPE WASH RESIDUAL SOIL 0.50: SPT Recovery: 0.45 r EXTREMELY WEATHERER ROCK
Wate	War (Dar War War Mar G	ter Level te and time sh ter Inflow ter Outflow anges radational or ansitional strat efinitive or dist	own)	Notes, Sai U ₅₀ CBR E ASS B Field Test PID DCP(×y)	50mm Bulk s Enviro (Glass Acid S (Plasti Bulk S	Diame ample nmenta jar, se sulfate c bag, ample onisati	ter tube sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm) etrometer test (test depth interval shown)	S S F F St S VSt \	ncy /ery Soft Soft Firm Stiff /ery Stiff Hard Friable V L	V Le	25 50 10 20 >4 ery Lo	CS (kPa 25 5 - 50 0 - 100 00 - 200 000 - 400 400 pose	D Dry M Moist W Wet W _p Plastic Limit Liquid Limit Density Index <15% Density Index 15 - 35%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

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JOB NO:

DATE:

ΒE

4-8-16

BH01

TRUCK MOUNTED RIG SURFACE RL:

DRILL TYPE: BOREHOLE DIAMETER: 100/50 mm DATUM: Drilling and Sampling Material description and profile information Testing Rock Mass Defects Defect Spacing WEATHERING CORE LIFT TEST METHOD GRAPHIC LOG Defect Description: Type, inclination, planarity, WATER Material Description: Rock type, RL **DEPTH** шш RQD $\rm I_{s(50)}D/A$ particle characteristics, colour, minor components, structure (m) (m) roughness, coating, thickness 0.5 1.0 1.5 08-09-2016 16:27 8:30.003 Datgel Lab and In Situ Tool 2.0 2.5 CORED BOREHOLE NEW16P-0119 - BOREHOLES.GPJ << DrawingFile>> START CORING AT 2.80m Extremely weathered SANDSTONE, breaks down into Sandy CLAY / Clayey SAND - fine to FW VI medium grained, pale brown. Not Observed 3.0 SANDSTONE - medium to coarse grained, grey to yellow-brown, with some iron staining in places. JT 80° SN UN RO 190 mm 83 SW D=0.66 MW A=0.32 1180 LEGEND: Method <u>I_{s(50)}</u> <0.1 Weathering Strength Defect Type Extremely Weathered Auger Screwing FW Very Low AS VI JT. .loint Water AD Auger Drilling HW Highly Weathered 0.1 - 0.3 РТ Parting L Low Water Level RR Roller/tricone MW Moderately Weathered М Medium 0.3 - 1 SM Seam (Date and time shown) Claw or Blade bit CB SW Slightly Weathered Н High 1 - 3 S7 Shear Zone Very High Water Inflow NMI C SS Sheared Surface NMI C Core FR Fresh VH 3 - 10■ Water Outflow EΗ Extremely High >10 CS Crushed Seam Strata Changes 8 Field Tests Roughness Coating <u>Planarity</u> QT LIB 1.1.GLB I Gradational or Very Rough Clean Hand Penetrometer VR CN PL Planar transitional strata RO Rough SN Stained CU Curved Definitive or distict SO Smooth VN Veneer ST Stepped strata change SL Slickensided CO Coating IR Irregular



LEND LEASE

PROJECT: PROPOSED EXPANSION

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4-8-16

LOGGED BY: RF

TRUCK MOUNTED RIG SURFACE RL:

LOCATION: CESSNOCK CORRECTIONAL CENTRE

DRILL TYPE: BOREHOLE DIAMETER: 100/50 mm DATUM: Drilling and Sampling Testing Material description and profile information Rock Mass Defects Defect Spacing WEATHERING ESTIMATED STRENGTH GRAPHIC LOG CORE LIFT TEST METHOD Defect Description: Type, inclination, planarity, WATER Material Description: Rock type, RL DEPTH шш RQD $I_{s(50)}D/A$ particle characteristics, colour, (m) (m) roughness, coating, minor components, structure thickness 5.8 SANDSTONE - medium to coarse grained, grey to yellow-brown, with some iron staining in places. (continued) SW Μ MW 1180 4.0 D=0.69 A = 0.95INTERLAMINATED SILTSTONE AND SANDSTONE - Sandstone is fine to medium grained, grey with some dark grey carbonaceous streaks. JT 35° SN UN RO 4.5 D=1.22 A=1.88 83 580 FR Н SW 5.0 JT 15° CN UN RO Not Observed NMLC 660 08-09-2016 16:27 8:30.003 Datgel Lab and In Situ Tool 5.5 PEBBLY SANDSTONE - medium to coarse grained, grey to yellow-brown. D=0.96 A=1.15 Μ JT 60° CN UN RO JT 60° CN UN RO HW Н 5.8 INTERLAMINATED SILTSTONE AND SANDSTONE - Sandstone is fine to medium grained, grey with some dark grey 6.0 carbonaceous streaks. 940 CORED BOREHOLE NEW16P-0119 - BOREHOLES.GPJ <<DrawingFile>> 96 FR Μ 6.5 D=0.74 A=0.71 JT 15° SN PL RO 80 JT 15° SN PL RO 50 -JT 15° SN PL RO LEGEND: Method <u>I_{s(50)}</u> <0.1 Weathering Strength Defect Type Extremely Weathered Auger Screwing Very Low AS FW VI JT. .loint Water AD Auger Drilling HW Highly Weathered 0.1 - 0.3 РΤ Parting L Low Water Level RR Roller/tricone MW Moderately Weathered М Medium 0.3 - 1 SM Seam (Date and time shown) Slightly Weathered Claw or Blade bit CB SW Н High 1 - 3 S7 Shear Zone Water Inflow Very High Sheared Surface NMI C SS NMI C Core FR Fresh VH 3 - 10■ Water Outflow EΗ Extremely High >10 CS Crushed Seam Strata Changes 8 Field Tests Roughness Coating **Planarity** Gradational or QT LIB 1.1.GLB Very Rough Clean Hand Penetrometer ٧R CN PLPlanar transitional strata RO Rough SN Stained CU Curved Definitive or distict SO Smooth VN Veneer ST Stepped strata change SL Slickensided CO Coating IR Irregular



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BH01

NEW16P-0119

LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE **DATE**: 4-8-16

DRILL TYPE: TRUCK MOUNTED RIG SURFACE RL:
BOREHOLE DIAMETER: 100/50 mm DATUM:

во	OREHOLE DIAMETER: 100/50 mm						DATUM:											
	Drill	ing and	Samplin	g	Material description and profile information						Testing			Rock M	ass Defects			
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle ch	escription: Rock haracteristics, co mponents, struct	olour,	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	ir	ect Description: Type, iclination, planarity, oughness, coating, thickness			
NMLC	Not Observed	8.8		7.5 - - 8.0 - 8.5		INTERLAMINATEI SANDSTONE - Sa grained, grey with carbonaceous stre	andstone is fine to	o medium	FR	М		96						
		8.8		9.0 9.5 		Hole Terminated a Target depth	t 8.80 m				D=0.97 A=0.73							
Wate	Wat (Dat - Wat I Wat ta Cha Gr tra	er Inflow er Outflo	ow al or I strata or distict	Metho AS AD RR CB NMLC	Au Au Ro Cl : Ni	iger Screwing iger Drilling iller/tricone aw or Blade bit MLC Core	HW Hiq MW Mo SW Sli	tremely Weather ghly Weathered oderately Weathe ghtly Weathered esh	ered	VL L M H VH EH	Low Medium High Very Hig	ıh Iy High	0.3 1 - 3 -	- 0.3 - 1 3 10				



ENGINEERING LOG - BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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BH02

4-8-16

LOGGED BY: ΒE

		YPE: OLE DIAM		JCK MOU ::	JNTED 100/50		SURF <i>A</i> Datui	ACE RL: VI:					
	Drill	ling and Sam	pling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity characteristics, colour, minor component		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
				-		SM	Silty SAND - fine to medium grained, grey-beneficially fine to medium grained gravel, sub-angular sub-rounded, root affected. Sandy CLAY - low to medium plasticity, red and orange-brown, fine to medium grained sub-rounded.	to -brown	M / M / N / N / N / N / N / N / N / N /	VSt	HP	310	TOPSOIL RESIDUAL SOIL
		0.50m SPT 5, 12, 17 N* = 29 D 0.95m		0.5_ - - - 1.0_		CL			M < W _P		HP	>600	0.50: SPT Recovery: 0.45 n
AD/T	Not Observed	2.00m		- 1.5_ - - - 2.0_		SC	Extremely weathered SANDSTONE - break into Clayey SAND - fine to medium grained yellow-brown.		D - M	н			EXTREMELY WEATHEREI ROCK
		D 2.20m		2.5_			Becoming grey. Continued as Cored Drill Hole		-				
				3.0									
	END:			Notes, Sar	•		iter tube sample	Consist	tency Very Sofi			CS (kPa) Moisture Condition D Dry
	Wat (Dat Wat Wat ta Cha	er Level e and time shader Inflow er Outflow unges radational or		CBR E ASS B Field Tests	Bulk s Enviro (Glass Acid S (Plasti Bulk S	ample nmenta jar, se ulfate s c bag, ample	ter due sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) on detector reading (ppm)	S F St VSt H Fb	Soft Firm Stiff Very Stiff Hard Friable	V	25 50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400	M Moist W Wet W _p Plastic Limit
	_ De	efinitive or distrata change		DCP(x-y) HP	Dynan	nic pen	etrometer test (test depth interval shown) ometer test (UCS kPa)		MI D VI	D	lediun ense ery De	n Dense ense	•



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BH02

LOCATION: CESSNOCK CORRECTIONAL CENTRE DATE: 4-8-16

DRILL TYPE: TRUCK MOUNTED RIG SURFACE RL:

во	REH	OLE D	IAMETE	ER:	100)/50 mm			DATU	JM:						
	Dril	ling and	Samplino	g		Material des	scription and p	profile information			Testing			Rock	Mass Defects	
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle ch	escription: Ro haracteristics, mponents, str	colour,	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	D	refect Description inclination, plar roughness, coa thickness	narity, ating,
				- 0.5 0.5 1.0 1.5 		START CORING A										
NMLC	Not Observed			2.5_ - - 3.0_ -		Extremely weather down into Clayey \$ \$ \ grained, yellow-bro SANDSTONE -fine grey, ironstaining i	SAND - fine to own e to medium g	o medium - — — — — — / rained, dark	SW - MW	H L - M	D=1.20 A=1.35	65	400	⊐—SM⊹	0° SN ST RO 5° Clay CO 20 n 30° Clay CO 50	
Wat ▼	Wat (Dat Wat Wat ta Cha tra D	ter Inflow ter Outflo	ow al or Il strata or distict	Metho AS AD RR CB NMLC	Au Au Ro Cl Ni [ests	uger Screwing uger Drilling blier/tricone aw or Blade bit MLC Core	MW	Extremely Weather Highly Weathered Moderately Weathe Slightly Weathered Fresh	ered	VL L M H VH EH	Low Medium High Very Hig	ıh ly High ugh	0.3 1 - 3 -	1 - 0.3 - 1 3 10	Defect Type JT Joint PT Parting SM Seam SZ Shear SS Sheare CS Crushe Plana an PL ned CU eer ST	Zone d Surface d Seam



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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4-8-16

LOGGED BY: ΒE

DRILL TYPE: TRUCK MOUNTED RIG SURFACE RL:

	Drill	ing and	Sampling	3		Material descri	ption and	profile information			Testing			Rock	Mass Defects
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	Material Desc particle chara minor compo	acteristics	, colour,	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	Di	efect Description: Type, inclination, planarity, roughness, coating, thickness
		5		- - 4.0_ - -		SANDSTONE -fine to grey, ironstaining in se			SW - MW		D=0.71 A=0.63	65	900	⇒— SM 5	5° Clay CO 10 mm
NMLC	Not Observed	5		4.5 - - - 5.0 -		Silty_SANDSTONE - fi	ine to coasi	rse grained	MW - HW	L M			50 50 100 70 60 20 70 150 40 30 40	— SM 5 — JT 10 — JT 30 — JT 80 — JT 80 — PT 5 — JT 30	5° Clay CO 20 mm 10° Clay CO 50 mm 5° Clay CO 50 mm 0° CN PL RO 0° CN PL RO 0° CN PL RO 5° CN UN RO 0° CN PL RO 0° SN ST RO 30° Clay CO 90 mm
	1			5.5 - - - 6.0		dark grey.		ico granca,	SW - HW		D=0.14 A=0.15	92			
				6.5		INTERLAMINATED S SANDSTONE - Sand grained, grey and dark	stone is fir	ne to coarse	FR	н	D=1.64 A=1.34				
Wate	Wat (Dat Wat	er Inflow er Outflo		NMLC	<u>d</u> Au Au Ro Cl Ni	ger Screwing E ger Drilling H siller/tricone M aw or Blade bit S	Veathering EW HW MW SW FR	Extremely Weather Highly Weathered Moderately Weath Slightly Weathered Fresh	ered	VL L M H VH	Low Medium High I Very Hig I Extreme	jh	0.3 1 - 3 - 1 >10	- 0.3 3 - 1 3 10 0	Defect Type JT Joint PT Parting SM Seam SZ Shear Zone SS Sheared Surfac CS Crushed Seam
	tra De	radationa insitional efinitive o rata char	strata or distict	Field 1		and Penetrometer				Rou VR RO SO	ighness Very Ro Rough Smooth	_	<u>Coa</u> CN SN VN	ting Clea Stair Vene	ned CU Curved



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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BOREHOLE NO:

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LOGGED BY: ΒE DATE: 4-8-16

DRILL TYPE: TRUCK MOUNTED RIG SURFACE RL:

	ILL T REH		AMETE			TED RIG 0/50 mm			ATU	ACE R M:	· - ·				
	Drill	ling and	Sampling	I		Material des	scription and profile inf	ormation			Testing			Rock Mas	ss Defects
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle ch	escription: Rock type, haracteristics, colour, mponents, structure	NEATHERING	WEALDERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	inc	ct Description: Type, lination, planarity, ughness, coating, thickness
NMLC	Not Observed	8.05		- - 7.5 -		SANDSTONE - Sa	D SILTSTONE AND andstone is fine to coar dark grey (carbonaced		R	н	D=2.34 A=3.34	92			
		8.05		8. <u>0</u>							D=0.91 A=1.29				
I FG	· SEND:			9.5 - 10.0 - Metho	d		Weathering			Stree	nath		I _{a(SO)}	, De	efect Type
_ _	Wat (Dat Wat Wat Ta Cha	er Inflow er Outflo	w al or I strata	AS AD RR CB NMLC	AL Ro CI NI Tests	uger Screwing uger Drilling oller/tricone aw or Blade bit MLC Core	HW Highly W MW Moderate	y Weathered eathered ely Weathered Veathered		VL L M H VH EH Rough	Very Low Low Medium High Very Hig Extremel ghness Very Rou Rough Smooth	h ly High	0.3 1 - 3 -	- 0.3 PT SI	PartingSeamShear ZoneSheared Surface



ENGINEERING LOG - BOREHOLE

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BH03

LOGGED BY: BE

LOCATION: CESSNOCK CORRECTIONAL CENTRE **DATE**: 2-9-16

DRILL TYPE:4WD MOUNTED RIGSURFACE RL:BOREHOLE DIAMETER:100/50 mmDATUM:

	REH(OLE DIAM			100/50		DATU	M:					
	Drill	ing and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTI (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
					-	CI	FILL: Sandy CLAY - medium plasticity, red orange-brown, fine to medium grained sand fine to medium grained gravel in top 20mm	d, trace	M × W				FILL - ACCESS TRACK
				0. 5			Sandy CLAY - medium plasticity, red-brown fine to medium grained sand.	n and grey,					RESIDUAL SÕIL
AD/T	Not Observed			1.5		CI			M ~ W _P	St - VSt			
				2.0									
				3.0	-		Extremely Weathered SANDSTONE, with s properties: breaks down into Clayey SANL medium grained, yellow-brown with some p estimated very low strength. 3.20m Continued as Cored Drill Hole	O - fine to	D - M	D - VD)		EXTREMELY WEATHERED ROCK
LEG Wate	END:			Notes, S			i eter tube sample	Consister VS V	ncy Yery Soft			CS (kPa) 25	Moisture Condition D Dry
Y	Wat (Dat Wat	er Level e and time sh er Inflow er Outflow	nown)	CBR E ASS	Enviro (Glas: Acid ((Plast	onmenta s jar, se Sulfate \$	for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled)	F F St S VSt V H H	oft irm tiff 'ery Stiff lard riable		50 10 20	5 - 50 0 - 100 00 - 200 00 - 400 400	M Moist W Wet W _p Plastic Limit W _L Liquid Limit
<u> </u>	Gr tra — De	radational or ansitional stra efinitive or dis rata change		Field Tes PID DCP(x-y) HP	its Photo Dynai	ionisati nic pen	on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa)	<u>Density</u>	V L ME D VE	L() N D	ery Lo oose lediun ense ery De	n Dense	Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



LOCATION: CESSNOCK CORRECTIONAL CENTRE

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2-9-16

LOGGED BY: BE

4WD MOUNTED RIG DRILL TYPE: SURFACE RL: 100/50 mm

ВО	BOREHOLE DIAMETER:			ER:	100	0/50 mm	DATUM:									
	Drill	ing and	Samplino	Material description and profile information							Testing			Rock	ck Mass Defects	
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle cl	escription: F haracteristic mponents, s	s, colour,	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	D	efect Description: Type, inclination, planarity, roughness, coating, thickness	
				0.5 - 1.0 1.5 - 2.0 - 2.5 - 3.0		START CORING	AT 2.20m									
DIWN LEG				-		Pebbly SANDSTO brown. Grey.	NE - fine to	<u> </u>	SW - MW FR	M - H	D=0.85 A=1.04 D=0.85	100				
	Wat (Dat - Wat	er Inflow er Outflo	ne shown	NMLC	Ai Ai Ri Cl Ni	uger Screwing uger Drilling oller/tricone aw or Blade bit MLC Core	Weatherin EW HW MW SW FR	g Extremely Weathe Highly Weathered Moderately Weath Slightly Weathered Fresh	ered	VL L M H VH EH	Low Medium High I Very Hig I Extreme	ıh	0.3 1 - 3 - 1 >10	1 - 0.3 - 1 3 10	Defect Type JT Joint PT Parting SM Seam SZ Shear Zone SS Sheared Surface CS Crushed Seam	
	tra De	adationa insitiona efinitive o ata char	l strata or distict	Field 1		and Penetrometer				Rou VR RO SO SL	Very Ro Very Ro Rough Smooth Slickens		Coa CN SN VN CO	ting Clea Stair Vene Coat	ned CU Curved eer ST Steppe	



ENGINEERING LOG - CORED BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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JOB NO: LOGGED BY:

BOREHOLE NO:

NEW16P-0119

DATE: 2-9-16

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:

во	BOREHOLE DIAMETER: 100/50 mm Drilling and Sampling Material description and pr							DATUM:									
	Drill	ing and	Samplin	g		Material des	scription and profile infor	mation			Testing			Rock	Mass Def	ects	_
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle ch	escription: Rock type, naracteristics, colour, mponents, structure		WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	D	inclinatio roughne	cription: Type n, planarity, ss, coating, kness	∍,
		3.7		- - 4.0_ - -		Pebbly SANDSTO brown. (continued Brown. Grey. Brown. Grey.	NE - fine to medium graii	ned,	FR SW FR SW MW	М -	A=1.18	100					
NMLC	Not Observed			4.5 - - 5.0 - - 5.5 - - -					FR	Н	D=1.29 A=1.68	100					
LEG	BEND:	6.05		6.5_ - -	d	Hole Terminated a	tt 6.05 m			Stre	A=1.85		I _{s(50}		Defect T	уре	
Wat	ter AS Water Level (Date and time shown) Water Inflow NMLC Water Outflow At Changes			AS Auger Screwing AD Auger Drilling AD Auger Dri			ered	VL L M H VH EH	Very Lov Low Medium High Very Hig	jh ly High ugh	<0. 0.1 0.3 1 - 3	1 - 0.3 - 1 3 10	JT PT SM SZ SS CS an need	ype Joint Parting Seam Shear Zone Sheared Surfa Crushed Sean Planarity PL Plana CU Curv ST Step IR Irregi	ar ed		



ENGINEERING LOG - BOREHOLE

LEND LEASE

PROJECT: PROPOSED EXPANSION

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BH04

LOGGED BY: ΒE

LOCATION: CESSNOCK CORRECTIONAL CENTRE DATE: 2-9-16

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:

DRILL TYPE: 4WD MOUNTED RIG BOREHOLE DIAMETER: 100/50 mm					SURFACE RL: DATUM:								
ВС		ling and Samp			100/30	, 111111	Material description and profile information	VI.			Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics,colour,minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
				0.5_		GP	Silty Sandy GRAVEL - fine to medium grain to brown, fine to coarse grained sand, fines plasticity, root affected. Sandy CLAY - medium to high plasticity, pafine to medium grained sand.	of low	M	VSt - H			FILL - TOPSOIL RESIDUAL SOIL
AD/T	Not Observed			1.0		sc	Extremely Weathered SANDSTONE, with s properties: breaks down into Clayey SAND medium grained, yellow-brown, estimated lost strength. Extremely Weathered SANDSTONE, with s properties: breaks down into Clayey SAND medium grained, yellow-brown, estimated v strength.	- fine to ow ^ coil - fine to	D - M	VD D - VD			EXTREMELY TO HIGHLY WEATHERED ROCK EXTREMELY WEATHERED ROCK
				2.5			Continued as Cored Drill Hole						
Wat	Water Level (Date and time shown) Water Inflow Water Outflow Water Outflow Cradational or transitional strata Definitive or distict CBR Environmental (Glass jar, see ASS Acid Sulfate S (Plastic bag, a Bulk Sample Field Tests PID Photoionisatio DCP(x-y) Dynamic pene					Diame ample nmenta jar, se culfate s c bag, ample onisationic pen	ter tube sample for CBR testing il sample aled and chilled on site)	S S S S S S S S S S S S S S S S S S S	ency Very Soft Soft Firm Stiff Very Stiff Hard Friable V L ME	Vi Lo	25 50 10 20 20 20 ery Lo	CS (kPa) 25 5 - 50 0 - 100 00 - 200 00 - 400 400 pose	D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit Density Index <15% Density Index 15 - 35%



ENGINEERING LOG - CORED BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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BOREHOLE NO:

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BH04

2-9-16

LOGGED BY: BE

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:

	OREHOLE DIAMETER: 100/50 mm							DATUM:							
	Drill	ling and	Samplin	g		Material des	scription and profile information			Testing			Rock I	Mass Defects	
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle ch	escription: Rock type, haracteristics, colour, mponents, structure	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm		efect Description: Typinclination, planarity, roughness, coating, thickness	
NMLC	Not Observed	3				brown, with extrem (Sandy CLAY) bar NO CORE: 60mm \[\] \[4.20m, judged to h \] \[2.30m. \] SANDSTONE - fin brown, with extrem (Sandy CLAY) bar INTERLAMINATEI SANDSTONE - sa	e to medium grained, dark nely weathered sandstone nds - 20mm to 80mm thick. ———————————————————————————————————	HW EW HW EW FR SW	М . H . H	D=0.82 A=1.03	10	220 250 60 120 20 70 30 80] 	Clay PL 220 mm Clay PL 60 mm Clay PL 20 mm Clay PL 30 mm	
Wate	Water Level (Date and time shown) Water Inflow Water Outflow AD Auger Drilling RR Roller/tricone CB Claw or Blade bit NMLC NMLC Core			uger Drilling oller/tricone aw or Blade bit	Weathering EW Extremely Weather HW Highly Weathered MW Moderately Weath SW Slightly Weathere FR Fresh	ered	Stre VL L M H VH	Low Medium High I Very Hig	jh	0.3 1 - 3 -	1 - 0.3 - 1 3 10	Defect Type JT Joint PT Parting SM Seam SZ Shear Zone SS Sheared Sur CS Crushed Sea			
Strat	Gi tra	Changes Gradational or transitional strata Definitive or distict strata change						Rou VR RO SO SL	ughness Very Ro Rough Smooth Slickens		Coa CN SN VN CO	ting Clear Stain Vene Coati	ed CU Cui er ST Ste	nar rved epped gular	



ENGINEERING LOG - CORED BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

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LOGGED BY: BE
DATE: 2-9-16

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:

во	BRILL TYPE: 4WD MOUNTED RIG BOREHOLE DIAMETER: 100/50 mm Drilling and Sampling Material description and profile in							DATU	JM:	ı					
	Drill	ing and	Sampling	9		Material des	scription and prof	file information		I	Testing		I	Rock Ma	ss Defects
METHOD	WATER	CORE LIFT / TEST	RL (m)	DEPTH (m)	GRAPHIC LOG	particle cl	escription: Rock naracteristics, co mponents, struct	lour,	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	inc	ct Description: Type, slination, planarity, ughness, coating, thickness
		4.2		4.0		INTERLAMINATE SANDSTONE - sa grained, grey to da (continued) 100mm band of Co	ndstone is fine to ark grey (carbona	medium aceous).			D=1.38 A=1.79	100			
NMLC	Not Observed	4.2		4.5 - -					FR - SW	н					
				5.0 - - - 5.5		100mm band of Co Possible Tuffaceou thick) - fine to med brown.	us SANDSTONE	(250mm		М	D=0.42 A=0.52 D=1.23 A=1.50	100			
		5.63		J. <u>J</u>							A=1.50				
LEG	BEND:			6. <u>0</u>	d	Hole Terminated a	t 5.63 m			Stre	ngth		L _{a(50}	a D	efect Type
<u>Wat</u>	wat (Dat - Wat Wat Wat - Gi - tra	er Inflow er Outflo nges radationa	ow al or Il strata or distict	AS AD RR	Au Au Ro Cl : Ni	ager Screwing ger Drilling oller/tricone aw or Blade bit MLC Core	EW Ext HW Hig MW Mo SW Sli	tremely Weather ghly Weathered derately Weathe ghtly Weathered ssh	ered	VL L M H VH EH	Very Low Low Medium High Very Hig	gh lly High ugh	<0. 0.1 0.3 1 - 3 -	1 J ⁻ - 0.3 P ⁻ - 1 Si 3 Si 10 Si 0 C	T Joint T Parting M Seam Z Shear Zone S Sheared Surface



ENGINEERING LOG - BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

PROJECT: PROPOSED EXPANSION

JOB NO:

PAGE:

BOREHOLE NO:

1 OF 3 NEW16P-0119

BH05

LOGGED BY: ΒE

DATE: 2-9-16

DRILL TYPE: **4WD MOUNTED RIG** SURFACE RL:

		YPE: OLE DIAMI) moun :	TED R 100/50		SURF. DATU	ACE RL: M:					
	Drill	ing and Sam	pling				Material description and profile information				Field	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticit characteristics, colour, minor componen		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
						SM	Silty SAND - fine to medium grained, grey- affected.	brown, root	М				TOPSOIL
				- - 0.5_			Sandy CLAY - medium to high plasticity, orange-brown with some red-brown and pa fine to medium grained sand.	e grey,	M ~ W _P	VSt			RESIDUAL SOIL
				1.0_ - -									
AD/T	Not Observed			1.5_ - -		СН			M < Wp	н			
				2.0									
				3.0			Becoming yellow-brown. 2.80m Extremely Weathered SANDSTONE, with s properties: breaks down into Clayey SAND medium grained, yellow-brown, estimated strength.	- fine to					EXTREMELY WEATHERED ROCK
				- - -					D - M	D - VD			
≚	Vater U₅₀ 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 Water Outflow Restrate Changes B Bulk Sample B Bulk Sample						ter tube sample or CBR testing I sample aled and chilled on site) Soil Sample	S So F Fi St St VSt Vo H Ha	cy ery Soft oft rm tiff ery Stiff ard iable		<2 25 50 10 20	CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400	D Dry M Moist W Wet D W _p Plastic Limit
<u> </u>	Gradational or transitional strata Definitive or distict strata change Field Tests PID Photoionisation detector reading (ppm) DCP(x-y) Dynamic penetrometer test (test depth interval shown) HP Hand Penetrometer test (UCS kPa)						etrometer test (test depth interval shown)	Density	V L ME D	Lo D D	ery Lo oose ledium ense ery De	n Dense	Density Index <15% Density Index 15 - 35% e Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100%



ENGINEERING LOG - BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

CLIENT: LEND LEASE

PROJECT: PROPOSED EXPANSION

PAGE:

BOREHOLE NO:

2 OF 3

BH05

ΒE

JOB NO: LOGGED BY: NEW16P-0119

DATE: 2-9-16

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:
BOREHOLE DIAMETER: 100/50 mm DATUM:

	Dril	ling and San	npling				Material description and profile information				Fiel	d Test	
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plastici characteristics,colour,minor componer		MOISTURE	CONSISTENCY DENSITY	Test Type	Result	Structure and additiona observations
AD/I				- - 4.0_			Extremely Weathered SANDSTONE, with properties: breaks down into Clayey SANE medium grained, yellow-brown, estimated strength. (continued)	- fine to	D - M	D - VD			EXTREMELY WEATHERS
				-			4.25m						
				-			Continued as Cored Drill Hole						
				4.5									
				_									
				-									
				5.0_									
				-									
				-									
				-									
				5.5									
				_									
				-									
				6.0									
				0.0_									
				6. <u>5</u>									
				-									
				-									
				Nata 2		J.T. (10			L	00 (12	Maintain Co. III
Wate	END: <u>er</u>			Notes, San	50mm	Diame	ter tube sample	1	Very Soft		<2	CS (kPa) 25	D Dry
T		ter Level		CBR E	Enviro	nmenta	or CBR testing I sample	F	Soft Firm		50	5 - 50 0 - 100	M Moist W Wet
-	•	te and time sh ter Inflow	1	ASS			aled and chilled on site) Soil Sample	1	Stiff Very Stiff			00 - 200 00 - 400	W _p Plastic Limit W _L Liquid Limit
Stree		ter Outflow		В	(Plast		air expelled, chilled)	Н	Hard Friable			100	
<u> </u>		radational or		Field Tests	<u>s</u>		on detector reading (nom)	Density	V		ery Lo	ose	Density Index <15%
		ansitional stra efinitive or dis		PID DCP(x-y)	Dynar	nic pen	on detector reading (ppm) etrometer test (test depth interval shown)		L MD	M		n Dense	,
_		rata change		HP	Hand	Penetro	meter test (UCS kPa)		D VD		ense	ense	Density Index 65 - 85% Density Index 85 - 100%



ENGINEERING LOG - CORED BOREHOLE

LOCATION: CESSNOCK CORRECTIONAL CENTRE

LEND LEASE

PROJECT: PROPOSED EXPANSION

PAGE: JOB NO: 3 OF 3

BH05

ΒE

NEW16P-0119

LOGGED BY: DATE: 2-9-16

BOREHOLE NO:

DRILL TYPE: 4WD MOUNTED RIG SURFACE RL:

	Drill	ing and	Sampling]		Material des	scription and profile inform	ation		Testing			Rock Mass D)efects
METHOD	WATER	CORE LIFT / TEST		DEPTH (m)	GRAPHIC LOG	particle ch	escription: Rock type, naracteristics, colour, mponents, structure	WEATHERING	ESTIMATED STRENGTH	I _{s(50)} D/A	RQD %	Defect Spacing mm	inclina roughi	escription: Type, tion, planarity, ness, coating, nickness
NMLC	Not Observed			- - 5.0_ - -		START CORING A Silty SANDSTONE dark grey. Brown. Dark grey. Brown. Dark grey. Brown.	AT 4.25m E - fine to medium grained,	SW - MW	М	D=0.42 A=0.34 D=0.49 A=0.63 D=0.89 A=0.74	86	1000	— JT 30° SN F → JT 30° SN F — JT 30° SN F	L RO
		5.6		6.0		Hole Terminated a	t 5.60 m						— JT 45° VN F	LSO
Vate	1120		AS Auger Screwing EW Extremely Wea AD Auger Drilling HW Highly Weather RR Roller/tricone MW Moderately We CB Claw or Blade bit SW Slightly Weather NMLC NMLC Core FR Fresh			nered Veathered	VL L M H VH	Low Medium High I Very Hig	ıh Ily High ugh	0.3 1 - 3 -	1 JT - 0.3 PT - 1 SM 3 SZ 10 SS CS	Joint Parting Seam Shear Zone Sheared Surface Crushed Seam Planarity PL Planar CU Curved ST Steppe		





Client:	LEND LEASE	Project No:	NEW16P-0	026
Project:	PROPOSED EXPANSION	Date:	4/03/2016)
Location:	CESSNOCK CORRECTIONAL CENTRE	Drowing No.	BH1-2	Sheet
Title:	CORE PHOTOGRAPHS	Drawing No:	DП I-2	1 of 3







	Client:	LEND LEASE	Project No:	NEW16P-C)119
ualtest	Project:	PROPOSED EXPANSION	Date:	6/09/2016)
LABORATORY (NSW) PTY LTD	Location:	CESSNOCK CORRECTIONAL CENTRE	Drawing No:	BH3-5	Sheet
	Title: CORE PHOTOGRAPHS		Drawing No:	рпо-о	1 of 1

APPENDIX B:

Results of Laboratory Testing



Point Load Strength Report - Diametral and Axial Testing of Rock Core

Client: Lend Lease Report No.: PL:NEW16W-2197 Project: Geotechnical Assesment - Cessnock Correctional Centre NEW16P-0119 Project No.: Location: Cessnock, NSW Work Order No: NEW16W-2197 Sample No.: S01

Date Sampled:	10-08-16
Date Tested:	12-08-16

3 Ironbark Close Warabrook NSW 230-

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ABN: 98 153 268 896

Issue Number: 1 This report replaces all previous issues

Accredited for compliance with ISO/IEC 17025.

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Approved Signatory:

Alan Cullen

WORLD RECOGNISED
ACCREDITATION

Title: Principal Geotechnician

Date of Issue: 12-08-16

Test Me	ethod: AS	5 4133.4.1 - 2007, Clau	ise 3.4, Ri	MS T223		Test M	achine:	HMA 6500) D	ate of Calibr	ration:	10-12-13			NATA Accredite	d Laboratory N	lumber:	18686
							Diametral Te	est						Ах	cial Test			
Borehole	Test Depth (m)	Rock Type	Moisture Condition	1	Diameter D (mm)	Load P (kN)	I _s (Mpa)	Size Correction	I _{s(50)} (Mpa)	Strength Classification	Width W (diameter) (mm)	Platen Separation D (mm)	Load P (kN)	I _s (Mpa)	Size Correction	I _{s(50)} (Mpa)	Strength Classification	Anisotropy Index I _{a(50)}
1	3.24	Sandstone	N	40.0	50.0	1.66	0.66	1.00	0.66	М	50.0	36.0	0.75	0.33	0.981	0.32	М	2.07
1	4.00	Sandstone	N	35.0	50.0	1.73	0.69	1.00	0.69	М	50.0	32.0	2.02	0.99	0.955	0.95	М	0.73
1	4.50	Interlaminated Siltstone & Sandstone	N	42.0	50.0	3.05	1.22	1.00	1.22	н	50.0	37.0	4.49	1.91	0.987	1.88	н	0.65
1	5.50	Pebbly Sandstone	N	42.0	50.0	2.39	0.96	1.00	0.96	М	50.0	37.0	2.74	1.16	0.987	1.15	н	0.83
1	6.49	Interlaminated Siltstone & Sandstone	N	40.0	50.0	1.86	0.74	1.00	0.74	М	50.0	36.0	1.65	0.72	0.981	0.71	М	1.05
1	8.77	Interlaminated Siltstone & Sandstone	N	45.0	50.0	2.42	0.97	1.00	0.97	М	50.0	38.0	1.79	0.74	0.993	0.73	М	1.32
2	2.96	Sandstone	N	40.0	50.0	2.99	1.20	1.00	1.20	н	50.0	36.0	3.15	1.37	0.981	1.35	н	0.89
2	3.81	Sandstone	N	38.0	50.0	1.77	0.71	1.00	0.71	М	50.0	34.0	1.41	0.65	0.968	0.63	М	1.12
2	5.32	Interlaminated Siltstone & Sandstone	N	50.0	50.0	0.35	0.14	1.00	0.14	L	50.0	47.0	0.44	0.15	1.041	0.15	L	0.91
2	6.09	Interlaminated Siltstone & Sandstone	N	45.0	50.0	4.10	1.64	1.00	1.64	н	50.0	42.0	3.52	1.32	1.015	1.34	н	1.23
2	7.90	Interlaminated Siltstone & Sandstone	N	34.0	50.0	2.27	0.91	1.00	0.91	М	50.0	30.0	2.61	1.37	0.941	1.29	н	0.71
2	7.00	Interlaminated Siltstone & Sandstone	N	45.0	50.0	5.86	2.34	1.00	2.34	н	50.0	40.0	8.47	3.33	1.004	3.34	VH	0.70
Moisture Co					lassification:													

Moisture Condition:

Strength Classification:

N = Natural S = Saturated

I_{s(50)} Mpa Abbreviation > 10 Extremely High Strength EH 3 to 10 Very High Strength VH 1 to 3 High Strength 0.3 to 1 Medium Strength М 0.1 to 0.3 Low Strength VL Very Low Strength < 0.1

QR00.46 26/05/14



Point Load Strength Report - Diametral and Axial Testing of Rock Core

Client:Lend Lease Building Pty LtdReport No.:PL:NEW16W-2197Project:Geotechnical Assessment - Cessnock Correctional CentreProject No.:NEW16P-0119Location:Cessnock, NSWWork Order No:NEW16W-2197Sample No.:So2

Date Sampled:	2/09/2016
Date Tested:	6/09/2016

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ABN: 98 153 268 896

Issue Number: 1

This report replaces all previous issues

NATA

ACCREDITATION

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Approved Signatory: Alan Cullen

WORLD RECOGNISED

Title: Principal Geotechnician

Date of Issue:

8/09/2016

Test Method: AS 4133.4.1 - 2007, Clause 3.4 Test Machine: HMA 6500 Date of Calibration: 10/12/2013 NATA Accredited Laboratory Number: 18686

				Diametral Test					Axial Test									
Borehole	Test Depth (m)	Rock Tyne	Moisture Condition	I amantla I	Diameter D (mm)	Load P (kN)	I _s (Mpa)	Size Correction	I _{s(50)} (Mpa)	Strength Classification	Width W (diameter) (mm)	Platen Separation D (mm)	Load P (kN)	I _s (Mpa)	Size Correction	I _{s(50)} (Mpa)	Strength Classification	Anisotropy Index I _{a(50)}
3	3.25	Pebbly SANDSTONE	N	40.0	50.0	2.13	0.85	1.00	0.85	М	50.0	35.0	2.37	1.06	0.974	1.04	Н	0.82
3	3.47	Pebbly SANDSTONE	N	40.0	50.0	2.13	0.85	1.00	0.85	М	50.0	33.0	2.58	1.23	0.962	1.18	Н	0.72
3	4.70	Pebbly SANDSTONE	N	38.0	50.0	3.22	1.29	1.00	1.29	н	50.0	35.0	3.84	1.72	0.974	1.68	Н	0.77
3	5.95	Pebbly SANDSTONE	N	37.0	50.0	4.13	1.65	1.00	1.65	н	50.0	39.0	4.60	1.85	0.998	1.85	н	0.89
4	2.40	SANDSTONE	N	36.0	50.0	2.06	0.82	1.00	0.82	М	50.0	33.0	2.25	1.07	0.962	1.03	н	0.80
4	3.00	SILTSTONE / Pebbly	N	35.0	50.0	2.35	0.94	1.00	0.94	М	50.0	29.0	2.58	1.40	0.934	1.31	Н	0.72
4	3.66	SANDSTONE	N	50.0	50.0	3.44	1.38	1.00	1.38	н	50.0	48.0	5.24	1.71	1.046	1.79	Н	0.77
4	4.96	Tuffaceous SANDSTONE	N	40.0	50.0	1.06	0.42	1.00	0.42	М	50.0	35.0	1.18	0.53	0.974	0.52	М	0.82
4	5.38	SILTSTONE / Pebbly SANDSTONE	N	35.0	50.0	3.08	1.23	1.00	1.23	н	50.0	29.0	2.96	1.60	0.934	1.50	н	0.82
5	4.28	Silty SANDSTONE	N	35.0	50.0	1.05	0.42	1.00	0.42	М	50.0	30.0	0.68	0.36	0.941	0.34	М	1.25
5	4.95	Silty SANDSTONE	N	50.0	50.0	1.22	0.49	1.00	0.49	М	50.0	48	1.85	0.61	1.046	0.63	М	0.77
5	5.34	Silty SANDSTONE	N	45.0	50.0	2.22	0.89	1.00	0.89	М	50.0	38	1.80	0.74	0.993	0.74	М	1.20

Moisture Condition:

Strength Classification:

N = Natural

S = Saturated

D = Dry

 I_{s(50)} Mpa
 Term
 Abbreviation

 > 10
 Extremely High Strength
 EH

 3 to 10
 Very High Strength
 VH

 1 to 3
 High Strength
 H

 0.3 to 1
 Medium Strength
 M

 0.1 to 0.3
 Low Strength
 L

Very Low Strength

< 0.1

QR00.46 26/05/14



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California Bearing Ratio Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: CBR:NEW16W-2185--S01

s report replaces all previous issues of report no 'CBR:NEW16W-2185--S01'.



Accredited for compliance with ISO/IEC 17025 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: 26/08/2016

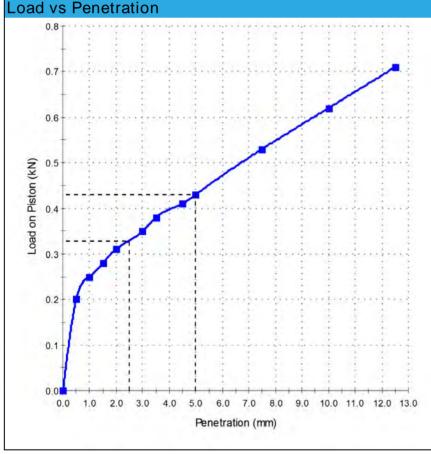
Sample Details

Sample ID: NEW16W-2185--S01 Date Sampled: 10/08/2016

Sampling Method: AS1289.1.2.1 cl 6.5.4

Source: On-Site Specification: No Specification Location: TP03 - (0.3 - 0.5m) Material: Sandy Clay

Project Location: Cessnock, NSW



Test Results	
AS 1289.6.1.1	
CBR At 2.5mm (%):	2.5
Maximum Dry Density (t/m³):	1.62
Optimum Moisture Content (%):	23.6
Dry Density before Soaking (t/m³):	1.61
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	24.0
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.58
Density Ratio after Soaking (%):	98
Swell (%):	2.0
Moisture Content of Top 30mm (%):	37.4
Moisture Content of Remaining Depth (%):	27.5
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0
Moisture Content	
Field Moisture Content (%):	23.8

Moisture Content Method Performed as Per AS1289.2.1.1. Laboratory Moisture Ratio (LMR): 101.5% Laboratory Density Ratio (LDR): 99.5%



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California Bearing Ratio Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: CBR:NEW16W-2185--S02

is report replaces all previous issues of report no 'CBR:NEW16W-2185--S02'.



Accredited for compliance with ISO/IEC 17025
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: 26/08/2016

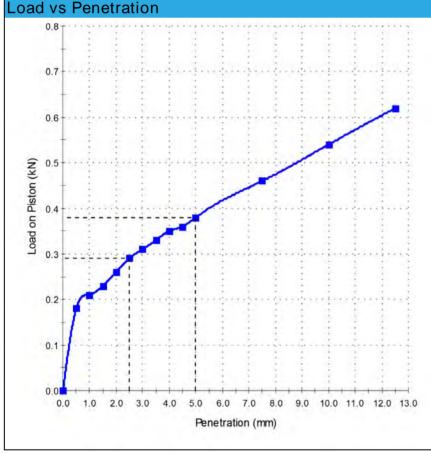
Sample Details

Sample ID: NEW16W-2185--S02 Date Sampled: 10/08/2016

Sampling Method: AS1289.1.2.1 cl 6.5.4

Source: On-Site Specification: No Specification Location: TP04 - (0.5 - 0.8m) Material: Sandy Clay

Project Location: Cessnock, NSW



Test Results	
AS 1289.6.1.1	
CBR At 2.5mm (%):	2.0
Maximum Dry Density (t/m³):	1.81
Optimum Moisture Content (%):	14.7
Dry Density before Soaking (t/m³):	1.81
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	14.5
Moisture Ratio before Soaking (%):	99
Dry Density after Soaking (t/m³):	1.75
Density Ratio after Soaking (%):	97
Swell (%):	3.0
Moisture Content of Top 30mm (%):	27.4
Moisture Content of Remaining Depth (%):	16.9
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0
Moisture Content	
Field Moisture Content (%):	13.7



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California Bearing Ratio Test Report

Lend Lease Building Pty Ltd

L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: CBR:NEW16W-2403--S01

is report replaces all previous issues of report no 'CBR:NEW16W-2403--S01'



Accredited for compliance with ISO/IEC 17025 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: 12/09/2016

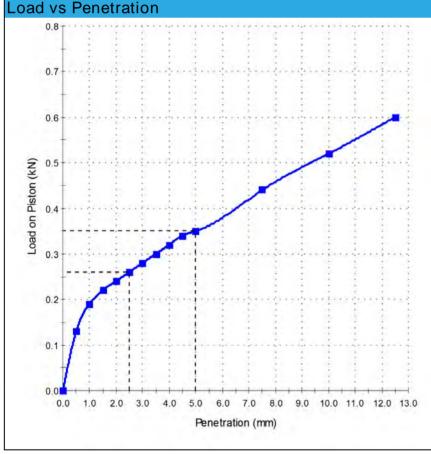
Sample Details

Sample ID: NEW16W-2403--S01 Date Sampled: 25/08/2016

Sampling Method: AS1289.1.2.1 cl 6.5.4

On-Site Specification: No Specification Source: Location: TP27 - (0.2 - 0.5m) Material: Clay

Project Location: Cessnock, NSW



Toot Doculto	
	2.0
` '	2.0
, ,	1.66
	20.9
, , ,	1.65
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	21.1
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.61
Density Ratio after Soaking (%):	97
Swell (%):	2.5
Moisture Content of Top 30mm (%):	32.9
Moisture Content of Remaining Depth (%):	23.8
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0
Moisture Content	
Field Moisture Content (%):	19.8
	Moisture Content before Soaking (%): Moisture Ratio before Soaking (%): Dry Density after Soaking (t/m³): Density Ratio after Soaking (%): Swell (%): Moisture Content of Top 30mm (%): Moisture Content of Remaining Depth (%): Compactive Effort: Surcharge Mass (kg): Period of Soaking (Days): Oversize Material (%): Moisture Content —

Moisture Content Method Performed as Per AS1289.2.1.1.

Laboratory Moisture Ratio (LMR): 101.0% Laboratory Density Ratio (LDR): 100.0%



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F: 02 4960 9775 E: admin@qualtest.com.au W: www.qualtest.com.au ABN: 98 153 268 896



California Bearing Ratio Test Report

Lend Lease Building Pty Ltd

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: CBR:NEW16W-2403--S02 Issue No: 1



Accredited for compliance with ISO/IEC 17025 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: 7/09/2016

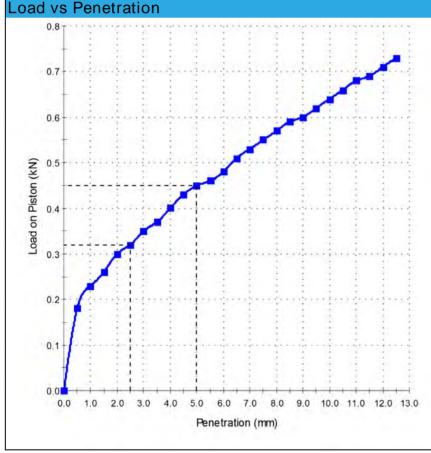
Sample Details

Sample ID: NEW16W-2403--S02 Date Sampled: 25/08/2016

Sampling Method: AS1289.1.2.1 cl 6.5.4

On-Site Specification: No Specification Source: Location: TP29 - (0.3 - 0.5m) Material: Clay

Project Location: Cessnock, NSW



Test Results	
AS 1289.6.1.1	
CBR At 2.5mm (%):	2.5
Maximum Dry Density (t/m³):	1.64
Optimum Moisture Content (%):	21.6
Dry Density before Soaking (t/m³):	1.64
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	21.8
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.61
Density Ratio after Soaking (%):	98
Swell (%):	1.5
Moisture Content of Top 30mm (%):	32.6
Moisture Content of Remaining Depth (%):	24.9
Compactive Effort:	Standard
Surcharge Mass (kg):	9.00
Period of Soaking (Days):	4
Oversize Material (%):	0.0
Moisture Content	
Field Moisture Content (%):	17.4

Moisture Content Method Performed as Per AS1289.2.1.1.

Laboratory Moisture Ratio (LMR): 101.0% Laboratory Density Ratio (LDR): 99.5%



F: 02 4960 9775 E: admin@qualtest.com.au W: www.qualtest.com.au ABN: 98 153 268 896



California Bearing Ratio Test Report

Lend Lease Building Pty Ltd Level 13, 224 Bunda Street

Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: CBR:NEW16W-2403--S03 Issue No: 1



Accredited for compliance with ISO/IEC 17025 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: 7/09/2016

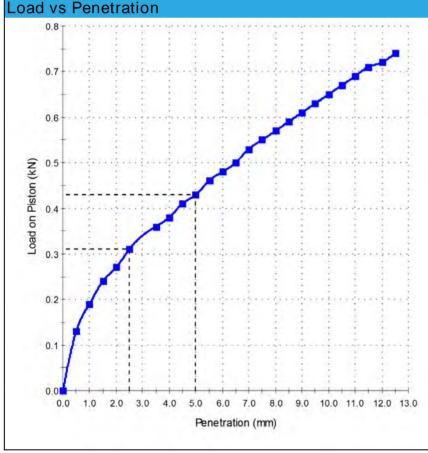
Sample Details

Sample ID: NEW16W-2403--S03 Date Sampled: 25/08/2016

Sampling Method: AS1289.1.2.1 cl 6.5.4

On-Site Specification: No Specification Source: Location: TP30 - (0.25 - 0.5m) Material: Clay

Project Location: Cessnock, NSW



	Test Results	
	AS 1289.6.1.1	
	CBR At 2.5mm (%):	2.5
	Maximum Dry Density (t/m³):	1.51
	Optimum Moisture Content (%):	27.5
	Dry Density before Soaking (t/m³):	1.52
	Density Ratio before Soaking (%):	100
	Moisture Content before Soaking (%):	26.9
	Moisture Ratio before Soaking (%):	98
	Dry Density after Soaking (t/m³):	1.50
	Density Ratio after Soaking (%):	99
	Swell (%):	1.5
	Moisture Content of Top 30mm (%):	37.4
	Moisture Content of Remaining Depth (%):	28.9
	Compactive Effort:	Standard
	Surcharge Mass (kg):	9.00
	Period of Soaking (Days):	4
	Oversize Material (%):	0.0
	——— Moisture Content ———	
	Field Moisture Content (%):	27.1
4		
- 1		

Moisture Content Method Performed as Per AS1289.2.1.1. Laboratory Moisture Ratio (LMR): 98.0% Laboratory Density Ratio (LDR): 100.5%



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S03 Issue No: 1



Accredited for compliance with ISO/IEC 17025 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: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S03

Test Request No.:

Material: Sandy Clay Source: On-Site Specification: No Specification

Project Location: Cessnock, NSW TP10 - (0.8 - 1.0m) Sample Location:

Borehole Number: Borehole Depth (m): 0.8 - 1.0 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

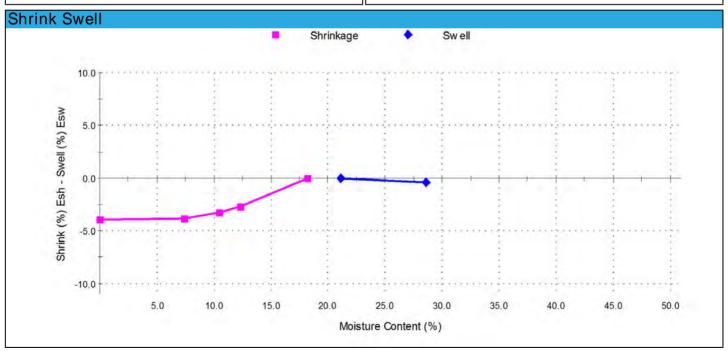
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): -0.4 21.1 Moisture Content before (%): Moisture Content after (%): 28.6 Est. Unc. Comp. Strength before (kPa): 500 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 3.9 Shrinkage Moisture Content (%): 18.2 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Minor



Shrink Swell Index - Iss (%): 2.1



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S04



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Approved Signatory: Dane Cullen

(Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S04

Test Request No.:

Material: Sandy Clay Source: On-Site Specification: No Specification

Project Location: Cessnock, NSW TP11 - (0.5 - 0.68m) Sample Location:

Borehole Number: Borehole Depth (m): 0.5 - 0.68 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

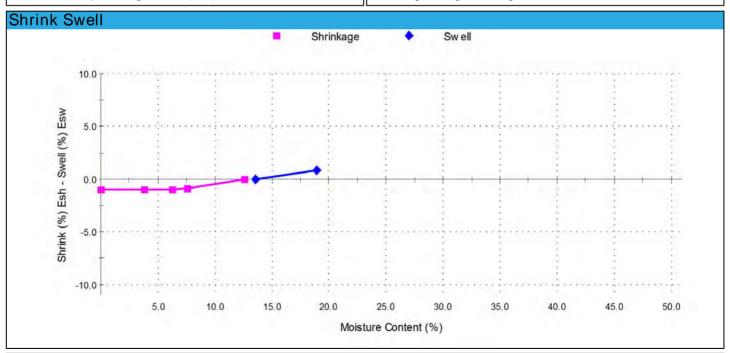
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 0.8 Moisture Content before (%): 13.6 Moisture Content after (%): 18.9 Est. Unc. Comp. Strength before (kPa): 480 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 1.0 Shrinkage Moisture Content (%): 12.5 Est. inert material (%): Nil Crumbling during shrinkage: Major Cracking during shrinkage:



Shrink Swell Index - Iss (%): 0.8



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S05 Issue No: 1



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Approved Signatory: Dane Cullen

(Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S05

Test Request No.:

Material: Sandy Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP12 - (0.5 - 0.75m) Sample Location:

Borehole Number: Borehole Depth (m): 0.5 - 0.75 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

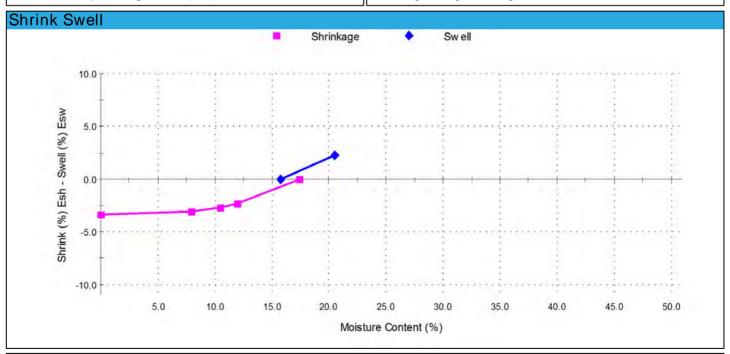
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 2.3 Moisture Content before (%): 15.7 Moisture Content after (%): 20.5 Est. Unc. Comp. Strength before (kPa): 580 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 3.4 Shrinkage Moisture Content (%): 17.4 Est. inert material (%): Crumbling during shrinkage: Nil Cracking during shrinkage: Nil



Shrink Swell Index - Iss (%): 2.5



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S06 Issue No: 1



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S06

Test Request No.:

Material: Sandy Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP17 - (0.6 - 1.0m) Sample Location:

Borehole Number: Borehole Depth (m): 0.6 - 1.0 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

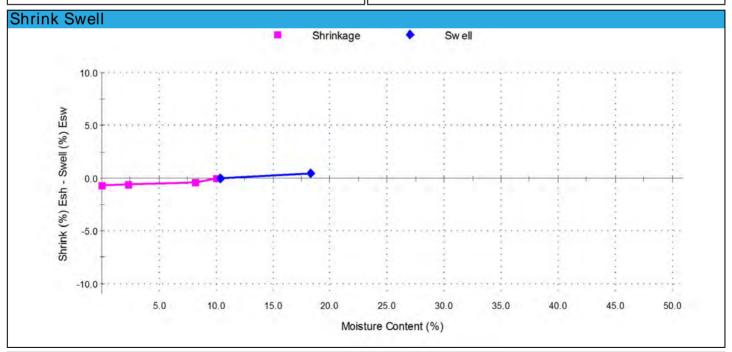
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

Swell Test	AS 1289.7.1.1

Swell on Saturation (%): 0.4 10.4 Moisture Content before (%): 18.3 Moisture Content after (%): Est. Unc. Comp. Strength before (kPa): 600 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 0.7 Shrinkage Moisture Content (%): 10.0 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Nil



Shrink Swell Index - Iss (%): 0.5



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S07 Issue No: 1



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Approved Signatory: Dane Cullen

(Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S07

Test Request No.:

Material: Sandy Clay Source: On-Site Specification: No Specification

Project Location: Cessnock, NSW TP18 - (0.5 - 0.90m) Sample Location:

Borehole Number: Borehole Depth (m): 0.5 - 0.9 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

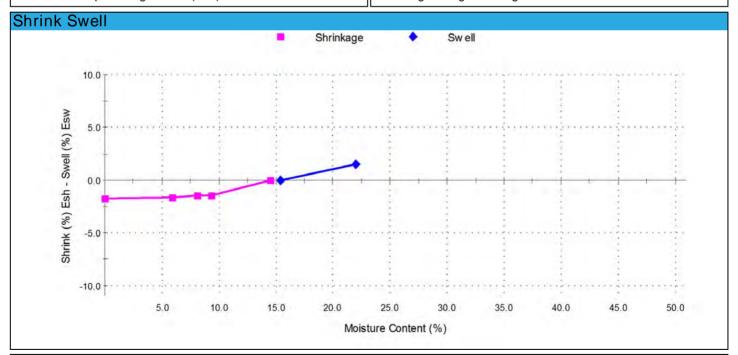
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): Moisture Content before (%): 15.4 Moisture Content after (%): 22.0 Est. Unc. Comp. Strength before (kPa): Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 1.7 Shrinkage Moisture Content (%): 14.5 Est. inert material (%): Crumbling during shrinkage: Nil Cracking during shrinkage: Moderate



Shrink Swell Index - Iss (%): 1.3



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S08 Issue No: 1



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S08

Test Request No.:

Material: Sandy Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP20 - (0.5 - 0.75m) Sample Location:

Borehole Number: Borehole Depth (m): 0.5 - 0.75 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

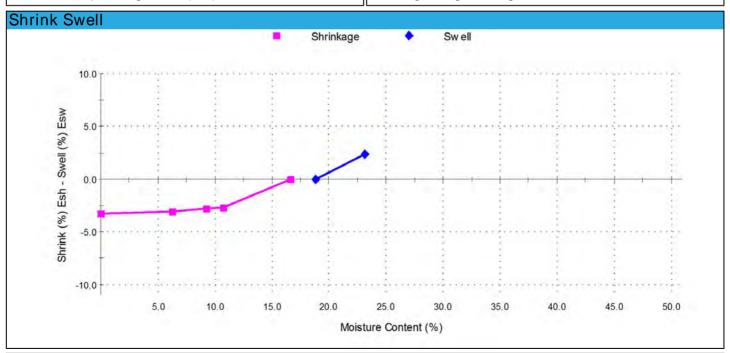
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 2.3 18.8 Moisture Content before (%): Moisture Content after (%): 23.1 Est. Unc. Comp. Strength before (kPa): 520 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 3.3 Shrinkage Moisture Content (%): 16.6 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Minor



Shrink Swell Index - Iss (%): 2.5



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S09 Issue No: 1



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Approved Signatory: Dane Cullen

(Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S09

Test Request No.:

Material: Sandy Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP21 - (0.5 - 0.68m) Sample Location:

Borehole Number: Borehole Depth (m): 0.5 - 0.68 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

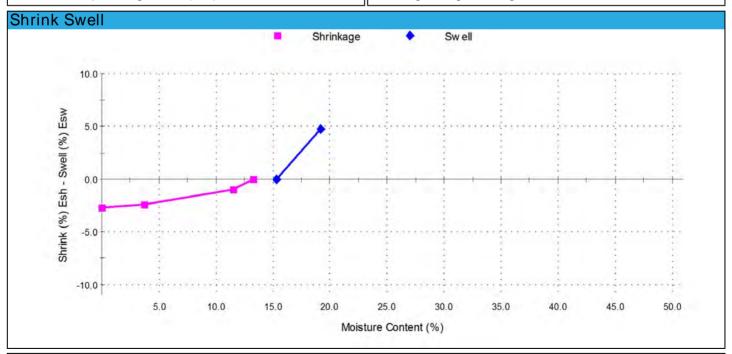
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

Swell Test	AS 1289.7.1.1	S
Swell on Saturation (%):	4.8	S

Moisture Content before (%): 15.3 19.1 Moisture Content after (%): Est. Unc. Comp. Strength before (kPa): 600 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): Shrinkage Moisture Content (%): 13.3 Est. inert material (%): Crumbling during shrinkage: Nil Cracking during shrinkage: Nil



Shrink Swell Index - Iss (%): 2.8



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Shrink Swell Index Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2185--S10 Issue No: 1



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 23/08/2016

Sample Details

Sample ID: NEW16W-2185--S10

Test Request No.:

Material: Sandy Clay Source: On-Site Specification: No Specification

Project Location: Cessnock, NSW TP23 - (0.4 - 0.70m) Sample Location:

Borehole Number: Borehole Depth (m): 0.4 - 0.7 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

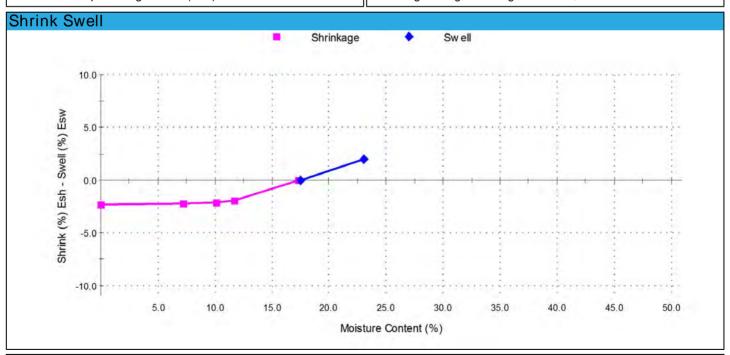
Date Sampled: 10/08/2016 Date Submitted: 11/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 17.5 Moisture Content before (%): Moisture Content after (%): 23.0 Est. Unc. Comp. Strength before (kPa): 600 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 2.3 Shrinkage Moisture Content (%): 17.3 Est. inert material (%): Nil Crumbling during shrinkage: Major Cracking during shrinkage:



Shrink Swell Index - Iss (%): 1.8



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Shrink Swell Index Report

Lend Lease Building Pty Ltd

L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2403--S04 Issue No: 1



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Approved Signatory: Dane Cullen

(Senior Geotechnician) NATA Accredited Laboratory Number: 18686 Date of Issue: 12/09/2016

Sample Details

Sample ID: NEW16W-2403--S04

Test Request No.:

Material: Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP27 - (0.2 - 0.5m) Sample Location:

Borehole Number: Borehole Depth (m): 0.2 - 0.5 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

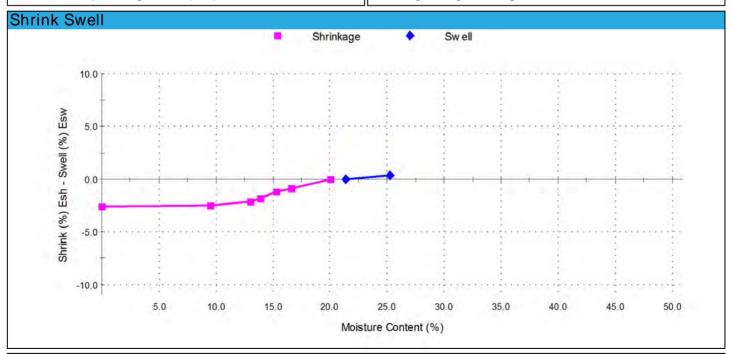
Date Sampled: 25/08/2016 Date Submitted: 30/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 0.4 Moisture Content before (%): 21.4 Moisture Content after (%): 25.2 Est. Unc. Comp. Strength before (kPa): 570 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 2.6 Shrinkage Moisture Content (%): 20.1 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Moderate



Shrink Swell Index - Iss (%): 1.5



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Shrink Swell Index Report

Lend Lease Building Pty Ltd

L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2403--S05 Issue No: 1



Accredited for compliance with ISO/IEC 17025 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: 12/09/2016

Sample Details

Sample ID: NEW16W-2403--S05

Test Request No.:

Material: Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP31 - (0.3 - 0.6m) Sample Location:

Borehole Number: Borehole Depth (m): 25.07 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

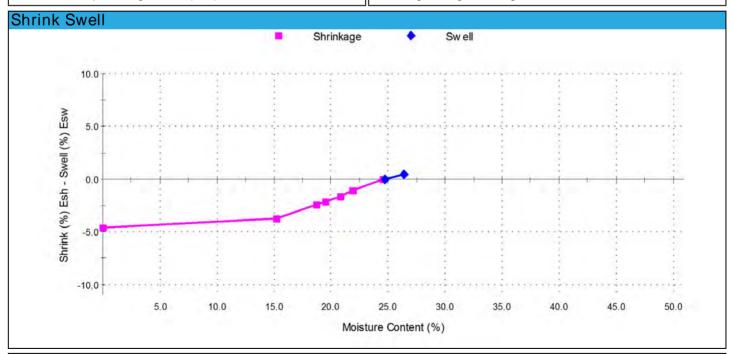
Date Sampled: 25/08/2016 Date Submitted: 30/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 0.4 Moisture Content before (%): 24.7 Moisture Content after (%): 26.3 Est. Unc. Comp. Strength before (kPa): 450 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 4.6 Shrinkage Moisture Content (%): 24.6 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Nil



Shrink Swell Index - Iss (%): 2.7



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Shrink Swell Index Report

Lend Lease Building Pty Ltd

L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: SSI:NEW16W-2403--S06 Issue No: 1



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(Senior Geotechnician) NATA Accredited Laboratory Number: 18686

Date of Issue: 12/09/2016

Approved Signatory: Dane Cullen

Sample Details

Sample ID: NEW16W-2403--S06

Test Request No.:

Material: Clay Source: On-Site

Specification: No Specification Project Location: Cessnock, NSW TP33 - (0.3 - 0.6m) Sample Location:

Borehole Number: Borehole Depth (m): 0.3 - 0.6 Client Sample ID:

Sampling Method: AS1289.1.2.1 cl 6.5.4

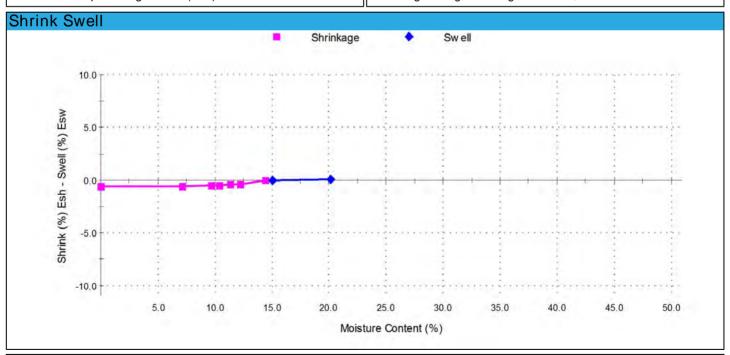
Date Sampled: 25/08/2016 Date Submitted: 30/08/2016

AS 1289.7.1.1 Swell Test

Swell on Saturation (%): 0.0 Moisture Content before (%): 15.0 Moisture Content after (%): 20.1 Est. Unc. Comp. Strength before (kPa): 560 Est. Unc. Comp. Strength after (kPa):

AS 1289.7.1.1 Shrink Test

Shrink on drying (%): 0.6 Shrinkage Moisture Content (%): 14.5 Est. inert material (%): Nil Crumbling during shrinkage: Cracking during shrinkage: Major



Shrink Swell Index - Iss (%): 0.4



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Report No: MAT: NEW16W-2198--S01

Issue No: 1



Principal:

Client:

Project No.: NEW16P-0119

Material Test Report

Project Name: Proposed Expansion of Cessnock Correctional Centre



Accredited for compliance with ISO/IEC 17025 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: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S01 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP03 - (0.30 to 0.60m)

Test Results

Description	Method	Result Limits
Emerson Class Number	AS 1289.3.8.1	4
Soil Description		Sandy CLAY
Type of Water		Distilled
Temperature of Water (°C)		20.0

Comments



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Report No: MAT: NEW16W-2198--S02

Issue No: 1

Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S02 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP08 - (0.60 to 0.80m)

Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



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Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Report No: MAT: NEW16W-2198--S03

Issue No: 1



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S03 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP11 - (0.50 to 0.70m)

Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



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Report No: MAT: NEW16W-2198--S04

Issue No: 1

Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S04 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP18 - (0.60 to 0.80m)

Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



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Report No: MAT: NEW16W-2198--S07

Issue No: 1

Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S07 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP20 - (0.50 to 0.75m)

Test Results

Description	Method	Result Li	imits
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



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Report No: MAT: NEW16W-2198--S05

Issue No: 1

Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S05 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP22 - (0.30 to 0.60m)

Test Results

Description	Method	Result Li	imits
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



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Report No: MAT: NEW16W-2198--S06

Issue No: 1

Material Test Report

Client: Lend Lease

Level 13, 224 Bunda Street Canberra City ACT 2600

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 16/08/2016

Sample Details

Sample ID: NEW16W-2198--S06 Sampling Method: AS1289.1.2.1 cl 6.5

Date Sampled: 10/08/2016 Source: On-Site Material: Sandy Clay Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP23 - (0.40 to 0.70m)

Test Results

Description	Method	Result Li	imits
Emerson Class Number	AS 1289.3.8.1	1	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		20.0	

Comments



Material Test Report

QUALTEST Laboratory (NSW) Pty Ltd (20708) 8 Ironbark Close Warabrook NSW 2304

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Report No: MAT: NEW16W-2403--S01

Issue No: 3

nis report replaces all previous issues of report no 'MAT:NEW16W-2403--S01'.



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 12/09/2016

WORLD RECOGNISED
ACCREDITATION

Principal: Project No.: NEW16P-0119

Lend Lease Building Pty Ltd L14, International Towers

Project Name: Proposed Expansion of Cessnock Correctional Centre

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Sample Details

Sample ID: NEW16W-2403--S01 Sampling Method: AS1289.1.2.1 cl 6.5.4

Date Sampled: 25/08/2016 Source: On-Site Material: Clay

Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP27 - (0.2 - 0.5m)

Test Results

Description	Method	Result Limits	S
Emerson Class Number	AS 1289.3.8.1	3	_
Soil Description		Clay	
Type of Water		Distilled	
Temperature of Water (°C)		17.3	

Comments



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Report No: MAT: NEW16W-2403--S02

Issue No: 1

Material Test Report

Lend Lease Building Pty Ltd L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre



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Approved Signatory: Dane Cullen (Senior Geotechnician)

NATA Accredited Laboratory Number: 18686 Date of Issue: 12/09/2016

Sample Details

Sample ID: NEW16W-2403--S02 Sampling Method: AS1289.1.2.1 cl 6.5.4

Date Sampled: 25/08/2016 Source: On-Site Material: Clay

Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP29 - (0.3 - 0.5m)

Test Results

Description	Method	Result Limits
Emerson Class Number	AS 1289.3.8.1	3
Soil Description		Clay
Type of Water		Distilled
Temperature of Water (°C)		17.3

Comments



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Report No: MAT: NEW16W-2403--S03

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NATA Accredited Laboratory Number: 18686 Date of Issue: 12/09/2016

Material Test Report

Lend Lease Building Pty Ltd

L14, International Towers

Exchange Place, 300 Barangaroo Ave, Sydney NSW 2000

Principal:

Project No.: NEW16P-0119

Project Name: Proposed Expansion of Cessnock Correctional Centre

Sample Details

Sample ID: NEW16W-2403--S03 Sampling Method: AS1289.1.2.1 cl 6.5.4

Date Sampled: 25/08/2016 Source: On-Site Material: Clay

Specification: No Specification Project Location: Cessnock, NSW Sample Location: TP30 - (0.25 - 0.5m)

Test Results

Description	Method	Result Limits	S
Emerson Class Number	AS 1289.3.8.1	3	_
Soil Description		Clay	
Type of Water		Distilled	
Temperature of Water (°C)		17.3	

Comments

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	
Н	Highly reactive clay sites, which can experience high ground movement from moisture changes	
Е	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.



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.

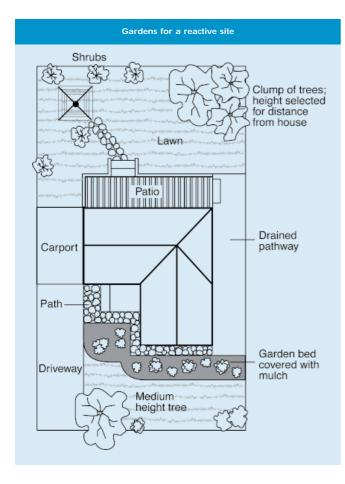
It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

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



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.

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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