Proposed Subdivision Stages 3 & 4 Pitt Street, Teralba Geotechnical Assessment

Pitt Street, Teralba

NEW15P-0070-AA.Rev1 28 August 2015



GEOTECHNICAL I LABORATORY I EARTHWORKS I QUARRY I CONSTRUCTION MATERIAL TESTING

28 August 2015

McCloy Group Suite 1, Level 3, 426 King Street NEWCASTLE WEST NSW 2309

Attention: Jon Hines

Dear Sir

RE: PROPOSED SUBDIVISION - STAGES 3 & 4 PITT STREET, TERALBA GEOTECHNICAL ASSESSMENT

Please find enclosed our Geotechnical Assessment report for the proposed residential subdivision of Stages 3 & 4, Pitt Street, Teralba.

The report includes recommendations for Site Classification in accordance with AS2870-2011, "Residential Slabs and Footings", pavement design and construction for internal subdivision roads, retaining wall design parameters and assessment of excavation conditions.

Qualtest have previously provided a Geotechnical Assessment report for the proposed subdivision (Reference: NEW15P-0070-AA, 13 July 2015). This revised report incorporates comments and recommendations on pavement design from Lake Macquarie City Council assessment letter (Reference: SCC/26/2015, 7 August 2015).

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

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

Esc Le.

Jason Lee Principal Geotechnical Engineer

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1.0 INTRODUCTION

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this report on behalf of McCloy Group (McCloy), for the proposed residential subdivision of Stages 3 & 4, Pitt Street, Teralba.

Based on drawings of the proposed subdivision provided by McCloy, the proposed development is understood to comprise subdivision into 38 residential lots for Stage 3 (Lots 301 to 338), 38 residential lots for Stage 4 (Lots 401 to 438), and construction of road pavements for internal subdivision roads as shown on Figure AA1.

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

- Site classification to AS2870-2011, "Residential Slabs and Footings" for residential lots within Stages 3 & 4.
- Pavement design for subdivision roads;
- Retaining wall design parameters;
- Recommendations for earthworks guidelines, including stability of cuttings, excavation conditions, and the suitability of the site soils for use as fill an on fill construction procedures;

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 22 June 2015 and comprised of:

- DBYD search of proposed test locations 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;
- Excavation of 18 test pits (TP01 to TP18) using a 20 tonne tracked excavator equipped with a 600mm wide toothed bucket, to depths of between 0.45m to 2.50m, within the proposed subdivision area;
- Bulk disturbed samples, undisturbed samples (U50 tubes), and small bag 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 Principal Geotechnical Engineer and Principal Geotechnician from Qualtest, who located the test pits, carried out the sampling and testing, and provided field logs.

Test pits were located relative to road centreline pegs installed by project surveyors and existing site features. Reduced levels of the test pits have been interpolated from the survey plans provided. Approximate test pit locations are shown on the attached Figure AA1.

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

Fieldwork and laboratory testing data from previous work conducted by Cardno Geotech Solutions on the adjoining Stage 2 (Ref: CGS1785, dated 19 December 2014), has been used to supplement information collected during the current investigations where applicable. Copies of the relevant test pit logs and laboratory test certificates are presented in Appendix C.

3.0 SITE DESCRIPTION

3.1 Surface Conditions

The site comprises Stages 3 & 4 of the proposed subdivision at Pitt Street, Teralba, as shown on Figure AA1 attached. The site is located to the south of the existing Stage 1 & 2 subdivision development, accessed off the end of Pitt Street.

The site is bounded by existing residential development and the current Stage 1 & 2 subdivision under construction to the north and north west. Undeveloped bushland, future stages of the subdivision development and future open space bound the remainder of the site, with the Main Northern Railway looping around the north, east and southern boundary of the entire development area.

The site is located within a region of gently to moderately undulating topography, on the southern facing upper to middle slopes of a prominent east trending spur. Site slopes generally vary from about 5° to 6° over the majority of the site, increasing up to angles in the order of about 8° to 10° on the upper slopes in the northern portion of the site, and 10° to 12° locally along the sides of a gully that runs along the southern boundary of the site.

Ground levels are generally in the range from about RL 51m (AHD) at the northern end of the site, falling to about RL 16m (AHD) on the southern end of the site.

The site is typically covered by undeveloped bushland, vegetated by a moderate to dense coverage of mature trees with an undergrowth of native shrubs, bushes and grass cover. A number of access tracks cross the site to provide access.

On the day of the investigation which was carried out following a period of wet weather, the majority of the site was judged to be moderately drained by way of surface runoff following the natural topography towards an incised gully that runs roughly along the southern boundary of the site, with infiltration during wet weather causing the near surface topsoil and colluvium soils to become wet and boggy in places. Trafficability was judged to be moderate by way of 4WD vehicle along the existing access tracks.

3.2 Subsurface Conditions

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

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

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

| Unit | Soil Type | Description |
|------|-----------------------------|--|
| 1 | TOPSOIL | Silty Clayey SAND - fine to medium grained, grey to brown, fines of low plasticity, root affected. |
| 2 | COLLUVIUM | Silty Clayey SAND, fine to medium grained, pale grey, grey and brown, fines of low plasticity; and Sandy CLAY, medium to high plasticity, pale brown yellow, sand fine to coarse grained. |
| 3 | RESIDUAL SOIL | Sandy CLAY, medium plasticity and medium to high plasticity, pale grey-brown, yellow-brown and mottled red-grey, sand fine to coarse grained; With depth grading into a Silty Sandy CLAY in places, sand content increasing, with some ironstone staining. |
| 4 | EXTREMELY WEATHERED ROCK | SANDSTONE, fine to medium grained, pale brown, pale grey- brown and red, assessed to be of low strength rock; CONGLOMERATE, excavating as a Clayey Sandy GRAVEL, fine to coarse grained pale brown-yellow. |
| 5 | HIGHLY WEATHERED ROCK | SANDSTONE, fine to medium grained, pale brown, pale grey- brown and red, assessed to be medium to high strength rock, with some very high strength bands; |

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES

The Unit 5 Highly Weathered Rock was encountered as indicated on the appended engineering logs and summarised in Table 2.

Test pits TP02, TP03 and TP16 located on the upper slopes of the ridge / spur line were terminated due to practical refusal of the 20 tonne excavator within highly weathered rock at depths of 0.70m, 0.45m and 0.60m, respectively.

Test pits TP05, TP08, TP11, TP15 and TP17 were terminated due to practical refusal of the 20 tonne excavator within highly weathered rock at depths varying from 1.1m to 2.2m.

The remaining test pits were terminated due to target depths being achieved.

No groundwater levels were encountered in the test pits during the limited time that they 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.

| Location | Unit 1 | Unit 2 | Unit 3 | Unit 4 | Unit 5 |
|----------|---|-------------|-------------------|------------------------|---------------------|
| | Topsoil | Colluvium | Residual | Extremely Weathered | Highly Weathered |
| | | | | Rock | Rock |
| | | D | epth in metres (r | n) | |
| TP01 | 0.00 - 0.30 | - | 0.30 - 3.00 | - | - |
| TP02 | 0.00 - 0.20 | - | 0.20 - 0.60 | - | 0.60 - 0.70 * |
| TP03 | 0.00 - 0.20 | - | 0.20 - 0.35 | - | 0.35 - 0.45 * |
| TP04 | 0.00 - 0.30 | 0.30 - 0.80 | 0.80 - 2.30 | - | 2.30 - 2.50 |
| TP05 | 0.00 - 0.13 | 0.13 - 0.25 | 0.25 - 1.40 | - | 1.40 - 1.60 * |
| TP06 | 0.00 - 0.20 | - | 0.20 - 2.20 | - | - |
| TP07 | 0.00 - 0.10 | 0.10 - 0.20 | 0.20 - 2.40 | - | - |
| TP08 | 0.00 - 0.15 | 0.15 - 0.30 | 0.30 - 1.10 | - | 1.10 - 1.90 * |
| TP09 | 0.00 - 0.15 | 0.15 - 0.30 | 0.30 - 2.00 | - | - |
| TP10 | 0.00 - 0.25 | 0.25 - 0.50 | 0.50 - 2.00 | - | - |
| TP11 | 0.00 - 0.20 | - | 0.20 - 0.80 | - | 0.80 - 1.10 * |
| TP12 | 0.00 - 0.20 | 0.20 - 0.40 | 0.40 - 1.80 | - | 1.80 - 2.20 |
| TP13 | 0.00 - 0.15 | 0.15 - 0.30 | 0.30 - 1.80 | - | 1.80 - 2.10 |
| TP14 | 0.00 - 0.30 | - | 0.30 - 2.10 | - | - |
| TP15 | 0.00 - 0.15 | 0.15 - 0.30 | 0.30 - 1.40 | - | 1.40 - 1.60 * |
| TP16 | 0.00 - 0.10 | - | 0.10 - 0.50 | - | 0.50 - 0.60 * |
| TP17 | 0.00 - 0.20 | 0.20 - 0.40 | 0.40 - 2.00 | - | 2.00 - 2.20 |
| TP18 | 0.00 - 0.13 | 0.13 - 0.25 | 0.25 - 1.30 | 1.30 - 2.20 | - |
| Notes: | * = Practical refusal of 20 tonne excavator met on Highly Weathered Rock. | | | | |

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

4.0 LABORATORY TESTING

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

- (6 no.) Shrink / Swell tests;
- (3 no.) Atterberg Limit tests;
- (6 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, Atterberg Limits, and CBR test results presented in Tables 3, 4 and 5.

| Location | Depth (m) | Material Description | Iss (%) |
|----------|-------------|----------------------|---------|
| TP09 | 0.40 - 0.70 | Sandy CLAY | 4.1 |
| TP11 | 0.50 – 0.80 | Sandy CLAY | 1.6 |
| TP13 | 0.40 - 0.70 | Sandy CLAY | 1.1 |
| TP13 | 1.10 - 1.40 | Sandy CLAY | 0.6 |
| TP15 | 0.40 - 0.70 | Sandy CLAY | 2.0 |
| TP18 | 0.40 - 0.70 | CLAY / Sandy CLAY | 0.9 |

TABLE 3 – SUMMARY OF SHRINK / SWELL TESTING RESULTS

TABLE 4 – SUMMARY OF ATTERBERG LIMITS TESTING RESULTS

| Location | Depth (m) | Material Description | Liquid Limit (%) | Plasticity Index (%) | Linear Shrinkage (%) |
|----------|-------------|----------------------|---------------------|-------------------------|----------------------------|
| TP06 | 0.40 - 0.80 | Sandy CLAY | 19 | 7 | 2.5 |
| TP07 | 0.40 - 0.70 | Sandy CLAY | 56 | 40 | 6.5 |
| TP17 | 0.40 - 0.80 | Sandy CLAY | 36 | 19 | 5.0 |

TABLE 5 – SUMMARY OF CBR TESTING RESULTS

| Location | Depth (m) | Field Moisture Content (%) | Optimum Moisture Content (%) | Relationship of Field MC to OMC (%) | CBR (%) |
|---|-------------|-------------------------------|------------------------------------|---|---------|
| TP04 | 0.40 - 0.60 | 23.1 | 23.5 | 0.4 dry | 4.0 |
| TP05 | 0.50 - 0.80 | 20.3 | 21.7 | 1.4 dry | 4.0 |
| TP12 | 0.50 - 0.80 | 29.5 | 26.4 | 3.1 wet | 3.5 |
| TP14 | 0.30 – 0.60 | 20.6 | 18.6 | 2.0 wet | 9 |
| TP17 | 0.40 - 0.80 | 15.1 | 14.6 | 0.5 wet | 7 |
| TP18 | 0.40 - 0.70 | 28.6 | 23.8 | 4.8 wet | 6 |
| Cardno Geotech Solutions - CBR testing (Ref: CGS1785, 19 December 2014) | | | | | |
| TP203 | 0.40 - 0.80 | 9.6 | 14.2 | 4.6 dry | 11 |
| TP206 | 0.50 – 0.90 | 11.6 | 15.5 | 3.9 dry | 17 |

Table 6 also include a summary of laboratory testing information where applicable from the previous Report on Geotechnical Investigation by Cardno Geotech Solutions (CGS) from the adjoining proposed Stage 2 development (Ref: CGS1785, 19 December 2014), with a copy of the CGS test results included in Appendix C.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Site Classification to AS2870-2011

Based on the results of the field work and laboratory testing, residential lots located within the proposed subdivision of Stages 3 & 4, Pitt Street, Teralba, as shown on Figure AA1, are classified in their current condition in accordance with AS2870-2011 '*Residential Slabs and Footings*', as shown in Table 6.

| Lot Numbers | Site Classification |
|---------------------------|---------------------|
| Stage 3 – Lots 301 to 338 | м |
| Stage 4 – Lots 401 to 438 | м |

TABLE 6 - SITE CLASSIFICATION TO AS2870-2011

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

Final site classification will be dependent on 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 of lots 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 the lots classified as **Class 'M'** in their existing condition. 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 D.

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

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.

5.2 Pavement Design

5.2.1 Design Subgrade CBR Values

Based on the results of the field work, laboratory testing, and previous experience in the surrounding area, the following design California Bearing Ratio (CBR) value has been adopted for pavement thickness design for proposed internal subdivision roads.

| Subgrade Material | Design CBR (%) | Comment |
|--------------------|----------------|---|
| Residual Clay Soil | 3.5 | All road sections unless stated otherwise |
| Residual Clay Soil | 5.0 | Pitt Street, Ch. 660m to 875m |
| Weathered Rock | 8.0 | Ripped and re-compacted |

 TABLE 7 – DESIGN SUBGRADE CBR VALUES
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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 5.4.

5.2.2 Design Traffic Loadings

The design traffic loading adopted for internal subdivision roads in accordance with Lake Macquarie City Council, Engineering Guidelines to The Development Control Plan, Part 1 – Design Guidelines, December 2013, in terms of equivalent standard axles (ESA's) is as follows:

| Road Section | Classification | Design Traffic (ESA's) |
|-----------------|----------------------|---------------------------|
| Pitt Street | Collector Road | 4 x 10 ⁶ |
| Bowline Street | Local Road | 4 x 10 ⁵ |
| Sail Street | Primary or Secondary | |
| Outrigger Drive | | |
| Road No. 6 | | |

TABLE 8 – DESIGN TRAFFIC LOADING

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

5.2.3 Flexible Pavement Thickness Design

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

- Lake Macquarie Development Control Plan 2014, Part 8 Subdivision Development, February 2014 – Revision 3;
- Lake Macquarie City Council, Engineering Guidelines to The Development Control Plan, Part 1 – Design Guidelines, December 2013;
- Lake Macquarie City Council, Engineering Guideline Part 1 Design Specification, D2 Pavement Design, September 2003;
- 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 9 and Table 10.

| Road Classification | Collector Road (Pitt Street) | | | |
|--------------------------------|------------------------------|-----------------------------|-----------------------------|--|
| Road Section | 300m – 660m | 660m - 875m | Clay Subgrade | |
| Design Traffic Loading (ESA's) | 4 x 10 ⁶ | 4 x 10 ⁶ | 4 x 10 ⁶ | |
| Design Subgrade CBR (%) | 8.0 | 5.0 | 3.5 | |
| Wearing Course (mm) | 45 – AC14 (Dense Graded) | 45 - AC14 (Dense Graded) | 45 - AC14 (Dense Graded) | |
| Base Course (mm) | 150 | 150 | 150 | |
| Subbase (mm) | 150 | 250 | 360 | |
| Select Fill (mm) | - | - | - | |
| Total Thickness (mm) | 345 | 445 | 555 | |

TABLE 9 – FLEXIBLE PAVEMENT THICKNESS DESIGN SUMMARY

<u>Notes:</u>

- 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.
- 6) Wearing course to be a minimum of 3 times the nominal mix size as specified by LMCC.

| Road Classification | Local Road – Primary or Secondary | | |
|--------------------------------|-----------------------------------|---------------------------|--|
| Road Section | Weathered Rock Subgrade | Clay Subgrade | |
| Design Traffic Loading (ESA's) | 4 x 10 ⁵ | 4 x 10 ⁵ | |
| Design Subgrade CBR (%) | 8.0 | 3.5 | |
| Wearing Course (mm) | 30 – AC10 (Gap Graded) | 30 - AC10 (Gap Graded) | |
| Base Course (mm) | 150 | 150 | |
| Subbase (mm) | 150 | 250 | |
| Select Fill (mm) | - | - | |
| Total Thickness (mm) | 330 | 430 | |

TABLE 10 – FLEXIBLE PAVEMENT THICKNESS DESIGN SUMMARY

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. As specified by LMCC, 'Where such situations arise, a minimum of 300mm thick select layer shall be provided in addition to the recommended pavement thickness included in Table 10'.
- 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.
- 6) Wearing course to be a minimum of 3 times the nominal mix size as specified by LMCC.

A select fill or bridging layer should be allowed for beneath the pavement in any areas where poor, wet or saturated subgrade conditions are encountered. This is discussed in Section 5.4.

If rock subgrade materials are encountered, 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 for a ripped and re-compacted rock subgrade based on a design subgrade CBR of 8% is provided.

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. Pavement Material Specification and Compaction Requirements are presented in Table 11.

| Pavement Course | Material Specification | Compaction Requirements |
|--------------------------------------|--|--|
| Wearing Course (AC) | Lake Macquarie City Council Specification | Lake Macquarie City Council Specification |
| Base Course | CBR ≥ 80%, PI ≤ 6% | 98% Modified (AS1289 5.2.1) |
| Subbase | CBR ≥ 30%, PI ≤ 12% | 95% Modified (A\$1289 5.2.1) |
| Select Fill / Stabilised Subgrade | Select, CBR ≥ 15%, PI ≤ 15%, max particle size 75mm | 95% Modified (AS1289 5.2.1) |
| | Or | |
| | * Stabilised Subgrade | |
| Subgrade (top 300mm) | Minimum CBR = 3.5% | 100% Standard (AS1289 5.1.1) |
| Subgrade / Fill Below | Minimum CBR = 3.5% | 95% Standard (AS1289 5.1.1) |

Notes:

- 1) Pavement materials for base course and subbase shall also comply with Lake Macquarie City Council Engineering Guideline, Part 2 Construction Specification, C242 Flexible Pavements, Tables C242.3 and C242.4.
- 2) CBR = California Bearing Ratio, PI = Plasticity Index.
- 3) Select Fill / Stabilised Subgrade options if required and/or adopted will be dependent on subgrade moisture conditions.

5.3 Excavation Conditions and Depth to Rock

The depths of fill, topsoil, colluvium, residual soils and weathered rock, together with depths of practical refusal of the 20 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). It is anticipated that these materials could be excavated by a conventional excavator or backhoe bucket;
- Weathered Rock (Unit 4 & 5). 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 4 & 5) material encountered could be excavated by conventional 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 20 tonne excavator bucket refusal will be excavatable by ripping to some greater depth, although this has not been assessed as part of the current investigation;

It is recommended that targeted investigations (e.g. cored boreholes) are carried out if significant excavations are proposed where bedrock depth or excavatability is important to design or construction.

The use of toothed buckets, ripping tynes, and/or hydraulic rock hammers may be required if hard bands of weathered rock are encountered or for deep confined excavations such as for service trenches. Higher strength rock or randomly occurring hard bands within the rock mass if encountered, are likely to occur towards the base of deeper cuts.

Preliminary recommendations based on excavation with a 20 tone excavator (noting practical refusal was met at relatively shallow depths) in the area of major cuttings are as follows:

- The majority of the rock is in the medium to high rock strength range, slightly fractured, with variable fracture spacings.
- Based on the findings 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 medium to large dozer such as a Caterpillar D9 or equivalent equipped with a single ripping tyne.
- Isolated beds of high to very high strength rock are likely to be encountered. 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.

Groundwater may exist at localised areas of the site such as within the topsoil / colluvium 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.

5.4 Recommended Batter Slopes

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

| GEOTECHNICAL | | MAXIMUM SLOPE OF EXCAVATED UNSUPPORTED BATTER | | | | | | |
|-----------------------------|--|--|--------------------------------|--|--|--|--|--|
| UNIT | MATERIAL TYPE | Temporary Excavations * | Permanent Excavations | | | | | |
| UNIT 1 & 2 | Topsoil & Colluvium | 1V:1H | 1V:3H | | | | | |
| UNIT 3 | Residual Soil | 1V:1H | 1V:2H | | | | | |
| UNIT 4 | Extremely Weathered Rock | 1V:0.5H | 1V:1.5H | | | | | |
| UNIT 5 | Highly Weathered Rock | 1V:1H | | | | | | |
| NOTE: * Subject orientat | ct to inspection during excavation to a ted defects or other conditions that ca | check for water inflo ould affect stability (| ow, adversely of the slope. | | | | | |

TABLE 12 - RECOMMENDED BATTER SLOPES

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

5.5 Retaining Wall Foundation Design Parameters

Retaining walls backfilled with a free draining granular material may be designed for an active earth pressure coefficient (k_a) of 0.33 and a passive earth pressure coefficient (k_p) of 3.0 and a total density of 1.9 t/m³, or alternatively the values shown in Table 13 may be adopted.

Allowance should be made for in the design of retention measures to resist hydrostatic pressures due to groundwater build-up in addition to earth pressures.

The parameters outlined in Table 13 may be used for retaining wall design. It is recommended that the design does not allow for any geotechnical strength for any uncontrolled fill if present.

| Soil Description | γ (kN/m³) | Su (kPa) | c' (kPa) | φ' (°) | Ev (MPa) | Eh (MPa) | ν | |
|--|--------------|----------|----------|--------|----------|----------|------|--|
| Controlled Fill (cohesive) | 19 | 75 | 5 | 27 | 15 | 11 | 0.35 | |
| Residual Soil (very stiff or better) | 19 | 75 | 5 | 27 | 15 | 11 | 0.35 | |
| Extremely to Highly Weathered Rock | 21 | 300 | 5 | 37 | 60 | 45 | 0.35 | |

TABLE 13 – GEOTECHNICAL SOIL PARAMETERS

<u>Note:</u>

 γ = Unit Weight S_u = Undrained Shear Strength

c' = Effective Cohesion

 ϕ' = Effective Friction Angle E_v = Vertical Young's Modulus

E_h = Young's Modulus

v = Poisson's Ratio

During progressive placement of fill behind the retaining wall it will displace outwards slightly. It is therefore recommended that the wall have an initial inward slope in the order of 5° prior to placement of fill.

An at rest earth pressure coefficient (k_o) should be used instead of an active earth pressure coefficient (K_a) behind the retaining structures for any walls that are relatively rigid and/or propped such as box culvert structures.

5.6 Site Preparation

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

- Following any 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;
- 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.

At the time of the field investigation, moisture content for the clay subgrade material tested varied from 1.4% dry to 4.8% wet of standard Optimum Moisture Content (OMC). It should therefore be anticipated that 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 materials are encountered at subgrade level, these materials should be over-excavated and be replaced with a minimum depth of 250mm of well graded granular select material with CBR of 15% or greater. The requirement for, and extent of subgrade replacement / select filling, should be confirmed by the geotechnical authority at the time of construction.

5.7 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 11;
- 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'.

5.8 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 Topsoil materials are expected to be suitable for landscaping purposes only;
- Unit 2 Colluvium 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 3 Residual Soils are generally expected to be suitable for re-use as general fill for engineering purposes. These materials will likely require some moisture conditioning;
- Unit 4 Extremely Weathered Rock and Unit 5 Highly Weathered Rock are generally expected to be suitable for re-use as general fill for engineering purposes.

Final selection of fill materials should consider properties such as reactivity which is typically moderate for site won Unit 3 Residual Soils, and low to moderate for site won Unit 4 Extremely Weathered Rock and Unit 5 Highly Weathered Rock.

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

5.9 Special Construction Requirements and 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.

It is recommended that surface and subsoil drainage be installed in line with the above advice, and in accordance with Lake Macquarie City Council (LMCC) specifications.

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.

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 pit locations. It should be noted that subsurface conditions between and away from the test pit locations may be different to those observed during the field work and used as the basis of the recommendations contained in this report.

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

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

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

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

the les

Jason Lee Principal Geotechnical Engineer

FIGURE AA1:

Approximate Test Pit Location Plan



APPENDIX A:

Results of Field Investigations

| | | | | E | ENGI | NEE | RING LOG - TEST PIT | | TE | ST PI | r no |): | TP01 |
|--|-----------------|------------------------------------|---------------|--------------|-------------------|-------------------------|---|--------------------------------------|---------------------|-------------|----------------|----------------------|---|
| C | | | tes | t 🧖 o | LIENT | : 1 | MCCLOY GROUP | | PA | GE: | | | 1 OF 1 |
| | | LABORATORY | INSWIPTY I | P | ROJE | CT: I | PROPOSED SUBDIVISION | | JO | B NO: | | | NEW15P-0070 |
| | | Distriction | ().seriji i i | | | | | | LO | GGED |) BY | : | AAC |
| | | | | L | OCAT | ION: S | STAGE 3 & 4 TERALBA | | DA | TE: | | | 22/6/15 |
| EC | QUIPN | IENT TYP | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE RL: | 47 | '.5 m | | | |
| TE | ST P | IT LENGT | H: | 2.0 m | W | IDTH: | 0.6 m | DATUM: | As | ssume | d | | |
| Drilling and Sampling Material description and profile information | | | | | | | | | | | Field | d Test | |
| 0 | ۲ ۳ | | | | <u></u> | L | | | ₩S | ×nc≺ | Эe | | Structure and additional |
| HHH | ATE | SAMPLES | RL (m) | DEPTH (m) | LOG | MBC/ | MATERIAL DESCRIPTION: Soil typ characteristics.colour.minor of | e, plasticity/particle components | ISTU | SISTE | st Ty | lesul | observations |
| ME | 3 | | | | 9 | SLASS | | | QNO | CON | Te | ш | |
| | | | | | 131131 | | Silty Clayey SAND - fine to mediu | ım grained, brown, | | | | | TOPSOIL / COLLUVIUM |
| | | | | | | SM | fines of little to low plasticity, with | some tree roots. | м | MD | | | |
| | | | | | | <u>_</u> | 0.30m | | _ | | | | |
| | | 0.50m | 47.0 | - | | | sandy CLAY - medium plasticity, sand fine to coarse grained. | pale grey brown, | | | | | RESIDUAL SUIL |
| | | 0.5011 | 47.0 | 0.5 | | | | | _0 | | | | |
| | | Б | |]] | | | | | × × | | | | |
| | | | | | | | | | | | | | |
| | | 0.90m | 16.5 | 1.0 | | | | | | | | | |
| | | | +0.5 | 1.0 | | | | | | | | | |
| | _ | | | | | | | | | | | | |
| | tered | | | | | | Becoming Silty Sandy CLAV with | rock structure with | | | | | |
| | coun | | 46.0 | 15 | | | depth, some ironstone staining. | | | | | | |
| ш | ot En | | 10.0 | 1.0 | | | | | | | | | |
| | z | | | | | CI | | | | St / VSt | | | |
| | | | | | | | | | | | | | |
| | | 2.00m | 45.5 | 2.0 | | | | | × | | | | |
| 3 | | | | | | | | | × | | | | |
| | | В | | | | | | | | | | | |
| | | 2.30m | | | | | | | | | | | |
| ige La | | | 45.0 | 2.5 | | | | | | | | | |
| 82 | | | | | | | | | | | | | |
| 2000 | | | | | | | | | | | | | |
| 24:21 | | | | | | | | | | | | | |
| | <u> </u> | | 44.5 | 3.0 | | 1 | 3.00m | | | | | | |
| 2 | | | | - | - | | Hole Terminated at 3.00 m | | | | | | |
| n lê | | | | | - | | | | | | | | |
| | | | | |] | | | | | | | | |
| 5 | | | 44.0 | 3.5 | | | | | | | | | |
| - | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | |]] | 1 | | | | | | | | |
| | | | | Notes Sa | | | ts | Concio | tency | | | CS (kP | a) Moisture Condition |
| | iter | | | | 50mn | n Diame | ter tube sample | VS | Very Soft | | <2 | 25 5 | D Dry M Moiet |
| - - | - Wat | ter Level | hown | E | Bulk S | onmenta | al sample | F | 50π Firm | | 25 50 |) - 50) - 100 | W Wet |
| | – Wat | ter Inflow | | ASS | (Glas Acid \$ | s jar, se Sulfate \$ | aled and chilled on site) Soil Sample | St VSt | Stiff Very Stiff | | 10 20 |)0 - 200)0 - 400 | W _p Plastic Limit W _L Liquid Limit |
| Str | ◀ Wat ata Ch | ier Outflow | | в | (Plast Bulk \$ | ic bag, Sample | air expelled, chilled) | H Fb | Hard Friable | | >4 | 100 | |
| | G | radational or | | Field Tes | ts Phote | ionisati | on detector reading (nom) | Densit | y V | Ve | ery Lo | ose | Density Index <15% |
| 2 | tra D | ansitional stra efinitive or di | ata stict | DCP(x-y) | Dyna | mic pen | etrometer test (test depth interval shown) | | ME |) M | ediun | n Dense | e Density Index 35 - 65% |
| | st | rata change | | пΡ | Hand | renetro | ometer test (UCS KPA) | | | D) Vi | ense erv De | ense | Density index 65 - 85% Density Index 85 - 100% |

| Ģ | ENGINEERING LOG - TEST PTI CLIENT: MCCLOY GROUP PROJECT: PROPOSED SUBDIVISION LOCATION: STAGE 3 & 4 TERALBA SUIPMENT TYPE: Volvo ECR235CL 20T Excavator SUBEACE | | | | | | | | TE PA JO LO DA | st pi Ge: B no Ggei Te: | T NC :) BY |): ': | TP02 1 OF 1 NEW15P-0070 AAC 22/6/15 |
|---------|---|---|--------------|--|---|--|---|--|--|-------------------------------------|---------------------------------------|---|---|
| E Ti | QUIPN EST P | MENT TYP | E: H: | Volvo 2.0 m | ECR2 W | 35CL /IDTH | 20T Excavator : 0.6 m | SURFACE RL: DATUM: | 51 As | l.0 m ssume | ed | | |
| | Dril | lling and Sar | npling | | | | Material description and profile infor | mation | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type characteristics,colour,minor cc | , plasticity/particle mponents | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | ered | | | | | SM | Silty Clayey SAND - fine to medium fines of low plasticity. | n grained, brown, | м | MD | | | TOPSOIL / COLLUVIUM |
| ш | Not Encounte | | 50. <u>5</u> | | | СН | Sandy CLAY - medium to high pla brown, sand fine to coarse grained | sticity, pale grey I. | M > W | St / VSt | - | | RESIDUAL SOIL |
| | | | | | <u> //////</u> | | O.70m SANDSTONE - fine to medium gra | | | | | | HIGHLY WEATHERED |
| | | | | | - | | Hole Terminated at 0.70 m Excavator Refusal | | | | | | |
| | | | 50. <u>0</u> | <u> </u> | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | 49.5 | 5 1. <u>5</u> | | | | | | | | | |
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| | | | 49. <u>0</u> | 2.0 | | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| Lage L | | | 48.5 | <u>5</u> 2. <u>5</u> | - | | | | | | | | |
| 00.000 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 48.0 | <u>)</u> 3.0 | - | | | | | | | | |
| 2 | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| 200 | | | 47.5 | <u>5</u> 3.5 | | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | | | | | | | | | |
| | EGEND: ater ∠ Wa (Da → Wa ◄ Wa rata Ch | ter Level te and time s ter Inflow ter Outflow anges | hown) | I Notes, Sa U ₅₀ CBR E ASS B Field Tes | mples a 50mn Bulk s Envire (Glass Acid s (Plast Bulk s | nd Tes n Diame sample conment s jar, se Sulfate tic bag, Sample | t ts ter tube sample for CBR testing al sample saled and chilled on site) Soil Sample air expelled, chilled) | Consist VS S F St VSt H Fb Density | Lency Very Soft Soft Firm Stiff Very Stiff Hard Friable | I | U 25 50 10 20 20 20 | CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400 | Moisture Condition D Dry M Moist W Wet Wp Plastic Limit WL Liquid Limit |
| | G tr D st | adational or ansitional stra efinitive or dia trata change | ata stict | PID DCP(x-y) HP | Photo Dynai Hand | ionisati mic per Penetr | on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa) | | L ME D | Li D N D D | lediun ense erv D | n Dense | Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| | (| ENGINEERING LOG - TEST PIT CLIENT: MCCLOY GROUP PROJECT: PROPOSED SUBDIVISION LOCATION: STAGE 3 & 4 TERALBA | | | | | | | | | | ST PI ⁻ GE: B NO: GGEI TE: | Г NC :) ВҮ |): : | TP03 1 OF 1 NEW15P-0070 AAC 22/6/15 |
|---|---------|--|---|--|-------------------------------------|--|--|---|---|--|--|---|---------------------------------|---|--|
| - | EQ | UIPN ST DI | | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFAC | E RL: | 49 |).5 m | d | | |
| ŀ | | Drill | ing and Sar | nolina | 2.0 11 | | | Material description and prof | ile information | | 7.0 | Sume | Fiel | d Test | |
| - | 0 | ~ | | | | <u></u> о | TION | | | | щZ | ۲ در | e | | Structure and additional |
| | METHO | WATEF | SAMPLES | RL (m) | DEPTH (m) | GRAPHI LOG | CLASSIFICA SYMBOI | MATERIAL DESCRIPTION: S characteristics,colour,n | oil type, plasticity/pa ninor components | article | MOISTUR | CONSISTER | Test Typ | Result | observations |
| | | untered | | | | | SM | Silty Clayey SAND - fine to low plasticity. | medium grained, fi | ines of | М | MD | | | TOPSOIL |
| | ш | ot Enco | | | | | СН | Sandy CLAY - medium to h 0.35m sand fine to coarse grained | ligh plasticity, pale l | brown, | × ₩ | St / VSt | | | |
| ŀ | | ž | | 49.0 | 0.5 | | | 0.45m SANDSTONE - fine to med ironstained. Hole Terminated at 0.45 m | ium grained, red | / | | н | | | ROCK |
| THE CONTRE DOTATION FOR THE TELETING OFFICIAL CONTRELLAR CONTRELLAR CONTRELLAR AND THE TOTATION | | END: er Vat (Dat Wat | er Level e and time s er Inflow er Outflow | 48.5 48.0 47.5 47.0 46.5 46.0 | | mples a 50mm Bulks a Enviro (Glass Acid S (Plast | nd Tes h Diame ample pument š jar, se Sulfate : c bag, | ts ter tube sample ter tube sample for CBR testing al sample saled and chilled on site) Soil Sample air expelled, chilled) | | Consiste VS VS S S St S VSt V H H | Incy /ery Soft Soft Firm Stiff /ery Stiff | | U <2 25 10 20 20 | CS (kPa) 5-50 -100 00 -200 00 - 400 | 1) Moisture Condition D Dry M Moist W Wet W_p Plastic Limit W_L Liquid Limit |
| | <u></u> | Gi Gi Di | radational or ansitional stra efinitive or dis rata chance | ata stict | Field Tesi PID DCP(x-y) HP | Photo Dynar Hand | ionisati nic pen Penetro | on detector reading (ppm) etrometer test (test depth interval sho ometer test (UCS kPa) | iwn) | <u>Density</u> | V L MD D | Ve Lo D M D | ery Lo bose ediun ense | oose n Dense | Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% |

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|---|---|----------------------|--------------|---------------------------|------------------------|-------------------------------|---|--|---|------------------------|---|--|---|
| E T | QUIPI EST P | VENT TYP IT LENGT | E: H: | Volvo 2.0 m | ECR2 | ACE RL: /I: | 38 As | 8.5 m ssume | ed | | | | |
| | Dri | lling and Sar | npling | | | | 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 | y/particle ts | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to medium grained brown, low plasticity. | l, pale | М | MD | | | TOPSOIL |
| | | 0.40m B 0.60m | 38. <u>0</u> | _ 0. <u>5</u> | | СН | Sandy CLAY - medium to high plasticity, pa yellow, sand fine to coarse grained. | le brown, | M > WP | VSt | | | |
| | ncountered | | 37. <u>5</u> | - 1.0_ | | | Sandy CLAY - medium to high plasticity mo grey, sand fine to coarse grained. | ttled red / | | | | | RESIDUAL SÕIL |
| ш | Not E | | 37. <u>0</u> | - 1. <u>5</u> | | СН | | | M < w _P | VSt / H | | | |
| | | | 36. <u>5</u> | 2.0_ | | | 2.30m Becoming weathered rock with depth. | | | | | | 2.20: Becoming friable with |
| | | | 36.0 | 25 | | | brown, highly weathered. | ey pale | D | Fb | | | HIGHLY WEATHERED ROCK |
| 6 0 0 | | - | 50.0 | | | | Hole Terminated at 2.50 m | | | | | | |
| | | | 35. <u>5</u> | 3.0_ | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 35.0 | 3. <u>5</u> | | | | | | | | | |
| | | | | | mples | Ind Tee | 15 | Consisto | ncv | | | CS (kP | a) Moisture Condition |
| Water U ₅₀ 50mm Diameter tube sample Water Level CBR Bulk sample for CBR testing (Date and time shown) E Environmental sample Water Inflow ASS Acid Sulfate Soil Sample Water Outflow (Plastic bag, air expelled, chilled) Bulk Sample Bulk Sample | | | | | | | ter tube sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) | VS V S S F F St S VSt V H H Fb F | /ery Soft Soft Firm Stiff /ery Stiff lard Friable | | 25 25 50 10 20 >2 | 25 5 - 50) - 100)0 - 200)0 - 400 400 | Moistail Control D Dry M Moist W Wet W Plastic Limit W Liquid Limit |
| | Strata Changes B Bulk Sample Fb Gradational or transitional strata PID Photoionisation detector reading (ppm) Definitive or distict strata change DCP(x-y) Dynamic penetrometer test (test depth interval shown) | | | | | | | | | Ve Lo D M De | ery Lo bose ediun ense ery De | n Dense | Density Index <15% Density Index 15 - 35% Density Index 15 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| Ģ | 6 | LABORATORY | | | ENGI CLIENT ROJE | NEE : CT: ION: | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION STAGE 3 & 4 TERALBA | r | T P J L | est Pi Age: Ob No Oggei Ate: | t NC : D BY |): ': | TP05 1 OF 1 NEW15P-0070 AAC 22/6/15 |
|--------|--|---|------------------------------|---|---|---|---|--|---|--|--|---|---|
| E T | QUIPMENT TYPE: Volvo ECR235CL 20T Excavator SURFACE RL: 29.0 m EST PIT LENGTH: 2.0 m WIDTH: 0.6 m DATUM: Assumed Drilling and Sampling Material description and profile information Field To | | | | | | | | | | | | |
| | Dril | lling and Sar | npling | | | | Material description and profil | e information | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: So characteristics,colour,mi | il type, plasticity/particle nor components | MOISTURE | CONSISTENCY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to r | nedium grained, pale | | | | | TOPSOIL |
| | | | | | | , SM | 0.25m Silty Clayey SAND - fine to r | nedium grained, pale | M | MD | | | |
| | ered | 0.50m | 28.5 | 0.5 | | | grey, tines of low plasticity. Sandy CLAY - medium plast grading to grey with depth, s grained. | icity, pale yellow brown and fine to coarse | × | St | _ | | RESIDUAL SOIL |
| ш | Not Encounte | B 0.80m | 28.0 | - 1. <u>0</u> | | CI | | | M < w | VSt | | | |
| | | | 27.5 | 1.5_ | | | 1.40m SANDSTONE - fine to media highly weathered. | um grained, pale browr | | н | | | HIGHLY WEATHERED |
| | | | 27.0 26.5 26.0 25.5 | | | | Excavator Refusal | | | | | | |
| | GEND: ater (Da − Wai | ter Level te and time s ter Inflow ter Outflow | hown) | I <u>Notes, Sa</u> U₅ CBR E ASS | mples a 50mn Bulk s Envire (Glass Acid s (Plast Bulk s | n Diame sample onment s jar, se Sulfate | ts ter tube sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) | Cons VS S F St VSt H Fb | istency Very S Soft Firm Stiff Very S Hard Friable | oft | <u>U</u> 2: 5: 1: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: | CS (kP 25 5 - 50 0 - 100 00 - 200 00 - 400 400 | Moisture Condition D Dry M Moist W Wet W Plastic Limit W Liquid Limit |
| | Strata Changes B Bulk Sample Fb — Gradational or transitional strata PID Photoionisation detector reading (ppm) Dens Definitive or distict strata change DCP(x-y) Dynamic penetrometer test (UCS kPa) Dens | | | | | | | <u>ty</u> | / V _ L MD N D D | /ery Lo .oose /lediur)ense /erv D | oose n Dense ense | Density Index <15% Density Index 15 - 35% e Density Index 15 - 65% Density Index 65 - 85% Density Index 85 - 100% | |

| (| 6 | Jual | tes | | ENGI CLIENT PROJE | NEE : । ст: । | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION | | TE PA JO | st pi ⁻ Ge: B NO: | |): | TP06 1 OF 1 NEW15P-0070 |
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| | | LABORATORY | (NSW) PTY | LID | OCAT | ION: S | STAGE 3 & 4 TERALBA | | LO DA | gged Te: |) BY | : | AAC 22/6/15 |
| E | QUIPI EST P | MENT TYP | E: H: | Volvo 2.0 m | ECR2 | 35CL /IDTH: | 20T Excavator 0.6 m | SURFACE RL: DATUM: | 40 As |).0 m ssume | ed | | |
| | Dri | lling and Sar | mpling | | | | Material description and profile info | rmation | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type characteristics,colour,minor c | e, plasticity/particle omponents | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | - } } | SM | Silty Clayey SAND - fine to mediu brown, fines of low plasticity. | m grained, pale | м | MD | | | TOPSOIL |
| | | 0.40m U50 0.80m | 39. <u>5</u> | - 0. <u>5</u> | | | Sandy CLAY - low to medium play grey brown mottles with ironstone to coarse grained. | sticity, pale yellow, staining, sand fine | M < Wp | VSt | | | RESIDUAL SOIL |
| Ш. | Not Encountered | | 39.0 38.5 38.0 | | | CL | Sand content increasing with dep | h. | M > Wp | Н | | | |
| | | | | | - | | Hole Terminated at 2.20 m | | | | | | |
| | | | 37.5 | 2.5 | - | | | | | | | | |
| | | | 37. <u>0</u> | - 3.0_ | - | | | | | | | | |
| | | | 36.5 | <u> </u> | - | | | | | | | | |
| | EGEND: <u>Vater</u> (Da (Da Wa Wa Wa trata Ch | ter Level te and time s ter Inflow ter Outflow anges tradational or | hown) | Notes, Sa U₅ CBR E ASS B Field Tes | 50mn Bulk s Enviro (Glas Acid s (Plast Bulk s | n Diame sample f onmenta s jar, se Sulfate S tic bag, Sample | ter tube sample for CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) | Consist VS S F St VSt H Fb Density | tency Very Soft Soft Firm Stiff Very Stiff Hard Friable | | <u>U</u> <2 25 50 10 20 >2 | CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400 pose | Moisture Condition D Dry M Moist W Wet W Plastic Limit WL Liquid Limit |
| | tr D S | ansitional str efinitive or di trata change | ata stict | PID DCP(x-y) HP | Photo Dynai Hand | ionisati nic pen Penetro | on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa) | | L MI D VF | La D M D D | oose ediun ense erv Dr | n Dense | Density Index 15 - 35% e Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| | | | | E | ING | NEE | RING LOG - TEST PIT | | TE | ST PI | T NC |) : | TP07 |
|-------------|---|----------------------------|--------------|---------------------|------------------|-----------------------|--|-----------------------|--------------------|----------------------|--|----------------------|---|
| 6 | | Jual | tes | † ° | | : | MCCLOY GROUP | | PA | GE: | | | 1 OF 1 |
| | | LABORATORY | (NSW) PTY L | .TD P | ROJE | CT: | PROPOSED SUBDIVISION | | JO | B NO: | | | NEW15P-0070 |
| | | | | | 0047 | | | | LO | GGEL |) BY | : | AAC |
| | | | | L | OCAT | ION: | STAGE 3 & 4 TERALBA | | DA | TE: | | | 22/6/15 |
| EG TE | UIPN ST PI | MENT TYP | E: H: | Volvo 2.0 m | ECR2 W | 35CL | 20T ExcavatorSURF.: 0.6 mDATU | ACE RL: M: | 31 As | l.0 m ssume | ed | | |
| | Drill | ling and Sar | npling | | | | Material description and profile information | | | | Fiel | d Test | |
| | | | | | 0 | NOI | | | u z | ς | 0 | | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICAT SYMBOL | MATERIAL DESCRIPTION: Soil type, plastici characteristics,colour,minor componer | ty/particle its | MOISTURE | CONSISTEN DENSITY | Test Type | Result | Structure and additional observations |
| | | | - | | | SM | 0.10m Silty Clayey SAND - fine to medium graine | d, pale | M | MD | | | |
| | | | | | | SM | 0.20m Silty Clayey SAND - fine to medium graine | / d, pale | | | - | | |
| | | 0.40m U50 0.70m | 30. <u>5</u> | 0. <u>5</u> | | CI | Sandy CLAY - medium plasticity, pale brov sand fine to coarse grained. | vn yellow, | M > w _P | | | | |
| | countered | 1.10m | 30. <u>0</u> | 1. <u>0</u> | | | 0.80m Sandy CLAY - medium plasticity, grey brow ironstone staining, sand fine to medium gr | vn with red ained. | | - | | | |
| ш | Not End | U50 1.40m | | | | | | | <u>م</u> | VSt | | | |
| | | | 29.5_ | 1.5 | | СІ | | | M N N | | | | |
| | | | 29. <u>0</u> | 2.0 | | | | | | | | | |
| | | | | | | | | | D | н | | | |
| | | | 28.5 | 2.5 | | 1 | 2.40m Hole Terminated at 2.40 m | | | | | | |
| ĺ | | | | | | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | 28.0 | 3.0 | | | | | | | | | |
| | | | | | - | | | | | | | | |
| 0 | | | | | - | | | | | | | | |
| | | | | | 1 | | | | | | | | |
| | | | 27.5 | 3.5 | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| 1 | | | | | - | | | | | | | | |
| | | | | |] | | | | | | | | |
| LEG | GEND: | | | Notes. Sa | mples a | nd Tes | l | Consiste | ncv | | | CS (kP | a) Moisture Condition |
| Wa | ter | | | | 50mn Bulk s | n Diame | eter tube sample for CBR testing | VS V | /ery Soft | | -2 -2 2F | 25 5 - 50 | D Dry M Moist |
| - | Wat | ter Level te and time s | hown) | E | Enviro | onment | al sample | F F | Firm | | 50 |) - 100 | W Wet |
| - I | - Wat | er Inflow | | ASS | (Glas | s jar, se Sulfate | areo ano chilleo on site) Soil Sample | VSt V | /ery Stiff | | 10 20 |)0 - 200)0 - 400 | $W_{\rm L}$ Plastic Limit $W_{\rm L}$ Liquid Limit |
| <u>Stra</u> | ¶ Wat ata Cha | er Outflow anges | | в | (Plast Bulk S | ic bag, Sample | air expelled, chilled) | H H Fb F | lard riable | | >4 | 100 | |
| | trata Changes B Bulk Sample Gradational or transitional strata Field Tests Definitive or distict strata change PID Photoionisation detector reading (ppm) Definitive or distict strata change DCP(x-y) Dynamic penetrometer test (test depth interval shown) | | | | | | | | | | ery Lo pose lediun ense ery Dr | n Dense | Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| | | | | E | INGI | NEE | RING LOG - TEST PIT | | | TE | ST PI | r no |): | TP08 |
|-----------|---|------------------------------------|--------------|---|---|-------------------------|--|----------------------------------|-------------|-----------------------|--------------|--|--------------------|---|
| (| CLIENT: MCCLOY GROUP PAGE: PROJECT: PROPOSED SUBDIVISION JOB NO: | | | | | | | | | | | | | 1 OF 1 |
| | X | LABORATORY | (NSW) PTY | | ROJE | CT: I | PROPOSED SUBDIVISION | | | JO | B NO: | | | NEW15P-0070 |
| | | | | | | | | | | LO | GGEE |) BY | : | AAC |
| | | | | L | OCAT | ION: S | STAGE 3 & 4 TERALBA | | | DA | TE: | | | 22/6/15 |
| E0 Te | QUIPN EST PI | IENT TYP | 'E: H: | Volvo 2.0 m | ECR2 W | 35CL / IDTH : | 20T Excavator 0.6 m | SURFACE R DATUM: | RL: | 33 As | .0 m sume | ed | | |
| | Drill | ling and Sar | mpling | | | | Material description and profile infor | mation | | | | Field | d Test | |
| | | | | | | NOI | | | | | сY | | | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICAT SYMBOL | MATERIAL DESCRIPTION: Soil type characteristics,colour,minor co | , plasticity/partic omponents | le | MOISTURE CONDITION | CONSISTEN | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to mediur | n grained, pale | | | | | | TOPSOIL |
| | | | | | | | Silty Clayey SAND - fine to mediur | m grained, pale | | М | MD | | | |
| | | 0.40m | | | | <u>}</u> −- | 0.30m grey. Sandy CLAY - medium plasticity, p | ale brown, sand | + | | | | | RESIDUAL SOIL |
| | | 0.40111 | 32.5 | 0.5 | | | fine to coarse grained. | | | | | | | |
| | | D | - |] _ | | | | | | | | | | |
| | red | 0.70m | - | | | CI | | | | × v | VSt | | | |
| | untei | | | | | | | | | Σ | | | | |
| ш | Enco | | 32.0 | 1.0 | | | | | | | | | | |
| | Not | | - |] _ | | <u> </u> | <u>1.10m</u> | | + | | | | | |
| | | | | | | | SANDSTONE - fine to medium gra extremely to highly weathered. | ained, pale brow | vn, | | | | | WEATHERED ROCK |
| | | | | | | | | | | | | | | |
| | | | 31.5 | 1.5 | | | | | | П | ц | | | |
| | | | | |]::::: | | | | | D | | | | |
| | | | | | | | | | | | | | | |
| | | | | | - · · · · · · · · · · · · · · · · · · · | | 1.90m | | | | | | | |
| | - | | 31.0 | 2.0 | | | Hole Terminated at 1.90 m | fusal of excavat | or | | | | | |
| 8 | | | | | - | | | | | | | | | |
| | | | | | - | | | | | | | | | |
| | | | | | 1 | | | | | | | | | |
| | | | 30.5 | 2.5 | 1 | | | | | | | | | |
| 8 | | | | | - | | | | | | | | | |
| 0.00 | | | | | - | | | | | | | | | |
| 2 | | | | | 1 | | | | | | | | | |
| 0710 | | | 30. <u>0</u> | 3.0 |] | | | | | | | | | |
| 2 | | | | | - | | | | | | | | | |
| III A | | | | | 1 | | | | | | | | | |
| ä V | | | |]] | 1 | | | | | | | | | |
| 5 | | | 29.5 | 3.5 | - | | | | | | | | | |
| | | | | | - | | | | | | | | | |
| | | | | | 1 | | | | | | | | | |
| | | | |]] | 1 | | | | | | | | | |
| | GENID | <u> </u> | <u> </u> | Notos Sa | | and Too | te . | 000 | eietono | ~~ | | | CS (kD | a) Moisture Condition |
| | ater | | | U ₅₀ | 50mm | n Diame | ter tube sample | VS | Ver | ry Soft | | <u>-</u> | 25 25 | D Dry |
| | Wat | ter Level | hours | E | Bulk s Envirr | ample f | or CBR testing al sample | S F | Sof Firr | π n | | 25 50 | 9 - 50) - 100 | W Moist W Wet |
| | (Dat – Wat | ter Inflow | nown) | ASS | (Glass Acid { | s jar, se Sulfate { | aled and chilled on site) Soil Sample | St VSt | Stif Ver | f ry Stiff | | 10 20 | 0 - 200 0 - 400 | W _p Plastic Limit |
| | ◀ Wat | er Outflow | | в | (Plast | ic bag, | air expelled, chilled) | | Har | rd able | | >4 | 100 | |
| <u>St</u> | G | anges radational or | | Field Test | ts | Janpie | | Den | sity | V | Ve | ery Lo | ose | Density Index <15% |
| | tra D | ansitional stra efinitive or di | ata stict | PID Photoionisation detector reading (ppm) Defisity DCP(x-y) Dynamic penetrometer test (test depth interval shown) Image: Control of the state of the s | | | | L MC | Lc M | oose edium | n Dense | Density Index 15 - 35% Density Index 35 - 65% | | |
| | st | rata change | - | HP | Hand | Penetro | ometer test (UCS kPa) | | | D VD | De Ve | ense ery De | ense | Density Index 65 - 85% Density Index 85 - 100% |

| | | | | | E | INGI | NEE | RING LOG - TEST PIT | | т | EST PI | T NC |): | TP09 |
|----------|------------|-----------------------|------------------------|-----------|-----------------|------------------|-------------------------|---|-------------------------|-----------------------------|-------------|---------------|---------------------|---|
| | | | alte | 20 | t 🎾 o | LIENT | : I | MCCLOY GROUP | | Р | AGE: | | | 1 OF 1 |
| | C | | | | P | ROJE | CT: I | PROPOSED SUBDIVISION | | J | OB NO | : | | NEW15P-0070 |
| | | | | | | | | | | L | OGGEI | D BY | : | AAC |
| | | | | | L | OCAT | ION: S | STAGE 3 & 4 TERALBA | | D | ATE: | | | 22/6/15 |
| E | QUI | PMEN | TYPE: | | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE RL | .: : | 35.0 m | | | |
| Т | EST | PIT LI | ENGTH: | | 2.0 m | W | IDTH: | 0.6 m | DATUM: | 1 | Assume | ed | | 1 |
| | | Drilling a | nd Sampl | ling | 1 | | 1 | Material description and profile inf | ormation | | | Fiel | d Test | - |
| L C | | | | | | ⊔ ⊔ | L | | | ᆔᆔ | | e | | Structure and additional |
| THO | | | IPLES | RL (m) | DEPTH | APHI OG | IFICA MBOI | MATERIAL DESCRIPTION: Soil typ | oe, plasticity/particle | STUF | | it Typ | esult | observations |
| MF | | | | () | (, | GR | LASS SY | | componento | ЮW W | | Tes | | |
| | - | _ | | | | | 0 | Silty Clavey SAND - fine to medi | um grained, pale | | | + | | TOPSOIL |
| | | | | - | - | | SM | 0.15m brown, pale grey, fines of low pla | asticity. | — м | MD | | | |
| | | | | - | | | SM | 0.30m grey, fines of low plasticity. | - — — — — — — — — | | | | | |
| | | 0.40 | m | - | | | | Sandy CLAY - medium to high p sand fine to medium grained. | lasticity, pale brown | ז, | | | | RESIDUAL SOIL |
| | | | 150 | 34.5 | 0.5 | | | | | | | | | |
| | | 0.70 | m | - | - | | | | | | | | | |
| | parad | | | - | | | | | | | | | | |
| | othe | | | - | | | | Deceming note growwith death | | | | | | |
| ш | | 2 | | 34.0 | 1.0 | | | Becoming pale grey with depth. | | | VSt | | | |
| | No | | | - | - | | СН | | | × | | | | |
| | | | | - | | | | | | ≥ | | | | |
| | | | | - | | | | Mottled red grey brown. | | | | | | |
| | | | | 33.5 | 1. <u>5</u> | | | | | | | | | |
| | | | | - | - | | | | | | | | | |
| | | | | - | | | | | | | | 1 | | |
| | | | | - | | | | | | | Н | | | |
| | | | | 33.0 | 2.0 | | 1 | Hole Terminated at 2.00 m | | | | | | |
| | | | | - | | | | | | | | | | |
| | | | | - | | - | | | | | | | | |
| al Lab | | | | - | - | - | | | | | | | | |
| n Latge | | | | 32.5 | 2.5 | 1 | | | | | | | | |
| :00:0£ | | | | - |]] | 1 | | | | | | | | |
| 2:42 8 | | | | - | - | - | | | | | | | | |
| | | | | 30.0 | | - | | | | | | | | |
| 10/01 | | | | JZ.U | 3.0 | 1 | | | | | | | | |
| grile>> | | | | - |]] | | | | | | | | | |
| Urawing | | | | - | - | - | | | | | | | | |
| v V | | | | 31 5 | 35 | - | | | | | | | | |
| 00/00 | | | | <u></u> |] | 1 | | | | | | | | |
| del M | | | | - | - | - | | | | | | | | |
| I NE | | | | - | - | - | | | | | | | | |
| ENT | | | | - | - | - | | | | | | | | |
| | EGEN | D: | I | 1 | Notes, Sa | mples a | nd Tes | t <u>s</u> ter tube sample | Consi | istency | oft | <u>U</u> | - CS (kPa 25 | a) Moisture Condition |
| | vater V | Vater Le | vel | (| CBR | Bulks | sample | for CBR testing | S - | Soft | | 25 | 5 - 50 | M Moist |
| | ([| Date and | I time show | wn) | F | Enviro (Glas | onmenta s jar, se | al sample aled and chilled on site) | F St | Firm Stiff | | 50 10 |) - 100)0 - 200 | W Wet W _p Plastic Limit |
| ► CN-CC | — v ⊸ v | vater Inf Vater Οι | ow tflow | 1 | ASS | Acid S (Plast | Sulfate S tic bag, a | Soil Sample air expelled, chilled) | VSt H | Very S [.] Hard | tiff | 20 >4 | 00 - 400 400 |) W _L Liquid Limit |
| _ 5 | trata (| Changes | i and at | | B Field Test | Bulk S | Sample | · | Fb Densi | Friable | / \/ | erv I o | ose | Density Index <15% |
| - I.GLB | | Gradati | onal or onal strata | | | Photo | oionisatio | on detector reading (ppm) | | | _ L | 00se | | Density Index 15 - 35% |
| | | Definiti strata c | /e or distic hange | τ ' | HP | Hand | Penetro | ometer test (UCS kPa) | | יי [\ |) C /D V | ense erv D | ense | Density Index 65 - 65% Density Index 85 - 100% |

| Ç | | LABORATORY | | E C P | | NEE : r ct: r | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION | | TE PA JO LO | st Pit Ge: B NO: GGED |) BY | : | TP10 1 OF 1 NEW15P-0070 AAC |
|---|---|---|--------------|---|---|---|---|--|--|--------------------------------|---|--|--|
| F | | | ۴۰ | Volvo | ECR2 | 35CI | 20T Excavator | | 23 | TE: | | | 22/6/15 |
| TE | EST PI | IT LENGT | <u>н</u> : | 2.0 m | W | IDTH: | 0.6 m D | ATUM: | As | sume | d | | |
| | Drill | iing and Sar | npling | T | <u> </u> | z | Material description and profile informa | ation | | | Field | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATIOI SYMBOL | MATERIAL DESCRIPTION: Soil type, pl characteristics,colour,minor com | asticity/particle ponents | MOISTURE | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to medium g brown. | rained, pale | | | | | TOPSOIL |
| | | | 22.5 | | | | 0.25m Silty Clayey SAND - fine to medium g grey. | grained, pale | - w | MD | | | |
| | countered | | 22.0 | 10 | | CI | Sandy CLAY - medium plasticity, pak fine to coarse grained. | e brown, sand | | St | | | RESIDUAL SOIL |
| Ш | Not En | | 22.0 | - 1.5 | | | Sandy CLAY - medium plasticity, pak ironstone mottled, sand fine to coarse | e grey, red e grained. | M > W | VSt | | | |
| | | | 21.0 | 2.0 | | | 2.00m Hole Terminated at 2.00 m | | | | | | |
| בידב סיטטיטט המושרו במי מות ווי כיגי יכיי | | | 20. <u>5</u> | - 2.5_ | | | | | | | | | |
| | | | 20. <u>0</u> | 3.0 | • | | | | | | | | |
| | | | 19. <u>5</u> | | | | | | | | | | |
| | GEND: ater ✓ Wat ✓ Dat ✓ Wat ✓ Wat | L :er Level te and time s ter Inflow ter Outflow | hown) | I <u>Notes, Sa</u> U₅₀ CBR E ASS | mples a 50mm Bulk s Envirc (Glass Acid s (Plast Bulk s | nd Tesi n Diame ample f onmenta s jar, se Sulfate s ic bag, Sample | ter tube sample ter tube sample or CBR testing al sample aled and chilled on site) Soil Sample air expelled, chilled) | Consiste VS F S St St H F F F F F F F | Arrow Soft Soft Firm Stiff Very Stiff Hard Friable | <u>.</u> | <u>U(</u> <2 25 50 10 20 >4 | 25 5 5 - 50 0 - 100 0 - 200 0 - 400 00 | Moisture Condition D Dry M Moist W Wet Wp Plastic Limit W_L Liquid Limit |
| | <u>ata Cha</u> Gi Di Di | anges radational or ansitional stra efinitive or dia trata change | ata stict | Field Test PID DCP(x-y) HP | Photo Dynar Hand | ionisationis Penetro | on detector reading (ppm) etrometer test (test depth interval shown) meter test (UCS kPa) | Density | V L ME D VD | Ve Lo D M De Ve | ery Lo ose edium ense ery De | iose 1 Dense | Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| (| 2 | ual | tes | st ^o c | ENGI CLIENT PROJE | NEE : । ст: । | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION | | TE: PA JO | st pi [.] Ge: B NO: | T NC |): | TP11 1 OF 1 NEW15P-0070 |
|------------|--------------------------------------|---|--------------------------------------|------------------------------------|--|---|---|--|--|------------------------------------|--|--|---|
| | | LABORATORY | (NSW) PTY | LTD | OCAT | ION: S | STAGE 3 & 4 TERALBA | | LO DA | ggei Te: |) BY | : | AAC 22/6/15 |
| EC TE | QUIPN ST P | MENT TYP | E: H: | Volvo 2.0 m | ECR2 | 35CL /IDTH: | 20T ExcavatorSURF/0.6 mDATUI | ACE RL: M: | 31 As | .0 m ssume | ed | | |
| | Dril | ling and Sar | 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 | y/particle ts | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to coarse grained, brown, low plasticity. | pale | м | MD | | | TOPSOIL |
| Э | Not Encountered | 0.40m U50 0.80m | 30.5ַ | - · · | | СН | Sandy CLAY - medium to high plasticity, gr mottles, sand fine to coarse grained, trace medium grained gravel. | rey brown fine to | M > W _P | St / VSt | - | | RESIDUAL SOIL |
| | | | 30. <u>0</u> | - · · · | | | SANDSTONE - fine to medium grained, rec weathered. | d, highly | D | н | | | HIGHLY WEATHERED ROCK |
| | | | 29.5 29.0 28.5 28.0 27.5 | | | | Hole Terminated at 1.10 m Excavator Refusal | | | | | | |
| | GEND: ter Wa (Da Wa | ter Level te and time s ter Inflow ter Outflow | hown) | Notes, Sa U₅ CBR E ASS | amples a 50mn Bulk s Enviro (Glass Acid s (Plast | n Diame sample i conmenta s jar, se Sulfate s tic bag, | ts eter tube sample for CBR testing al sample saled and chilled on site) Soil Sample air expelled, chilled) | Consister VS F St VSt H | ency Very Soft Soft Firm Stiff Very Stiff Hard | | U 25 50 10 20 | <u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400 | Moisture Condition D Dry M Moist W Wet W Plastic Limit W Liquid Limit |
| <u>Str</u> | a <u>ta Ch</u> G tr D si | anges Fradational or ansitional stra refinitive or dis trata change | ata stict | PID DCP(x-y) HP | Buik S ts Photo Dynai Hand | ionisati nic pen Penetro | on detector reading (ppm) etrometer test (test depth interval shown) ometer test (UCS kPa) | Density | V L ME D Vn | V La D M D | ery Lo bose lediun ense ery Da | oose n Dense | I Density Index <15% |

| | | | e. | | E E | INGI | NEE | RING LOG - TEST PIT | | | TE | ST PI | |): | TP12 |
|--------|-------------|----------------------|----------------------------------|--------------|----------------|------------------|----------------------|---|--------------------|----------------|------------------|--------|----------------|---------------------|---|
| | C | | Indi | too | t 🧖 c | LIENT | : 1 | MCCLOY GROUP | | | PA | GE: | | | 1 OF 1 |
| | 2 | X | LABORATORY | | P | ROJE | CT: I | PROPOSED SUBDIVISION | | | JO | B NO: | | | NEW15P-0070 |
| | | | LABORATORY | (19044)1-111 | | | | | | | LO | GGED |) BY | : | AAC |
| | | | | | L | OCAT | ION: S | STAGE 3 & 4 TERALBA | | | DA | TE: | | | 22/6/15 |
| | EQ | UIPN | IENT TYP | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE | E RL: | 29 | .5 m | | | |
| | TE | ST PI | T LENGT | H: | 2.0 m | W | IDTH: | 0.6 m | DATUM: | | As | sume | d | | |
| | | Drill | ing and Sar | npling | | | 1 | Material description and profile in | nformation | | | | Field | d Test | |
| | ~ | | | | | 0 | NOL | | | | шZ | , Ľ | e | | |
| | I E E | TER | SAMPLES | RL | DEPTH | BHIO | FICA ⁻ | MATERIAL DESCRIPTION: Soil ty | /pe, plasticity/pa | article | STUR DITIO | STEN | Typ | sult | observations |
| | ΜE | W۹ | | (m) | (m) | GR | ASSI SY1 | characteristics,colour,minor | r components | | MOIS | DEI | Test | R | |
| | | | | | | | ъ С | | | | | 0 | | | |
| | | | | | | $ \{ \} $ | SM | brown, fines of low plasticity. | dium grained, pa | ale | | | | | |
| | | | | | | | <u> </u> | Silty Clayey SAND - fine to med | dium grained, pa | ale | М | MD | | | |
| | | | | |]] | | SM | grey, fines of low plasticity. | | | | | | | |
| | | | 0.50m | 29.0 | 0.5 | | | Sandy CLAY - medium to high medium grained. | plasticity, sand | fine to | | | | | RESIDUAL SOIL |
| | | | D | | | | | | | | | | | | |
| | | | 0.80m | | | | | | | | | | | | |
| | | red | 0.00111 | | | | | Some ironstone inclusions. | | | | | | | |
| | | ounte | | 28.5 | 1.0 | | | | | | | | | | |
| | ш | Enco | | | | | СН | | | | × × | VSt | | | |
| | | Not | | | | | | | | | 2 | | | | |
| | | | | | | | | | | | | | | | |
| | | | | 28.0 | 1.5 | | | | | | | | | | |
| | | | | | | | | | | | | | | | 1.50: Becoming stiffer with depth and developing rock |
| | | | | | | | | | | | | | | | structure. |
| | | | | | | | 1 | SANDSTONE / SILTSTONE - f | ine to medium | | | | | | HIGHLY WEATHERED |
| | | | | 27.5 | 2.0 | | | grained, pale grey brown, highly | y weathered. | | П | ц | | | ROCK |
| 3 | | | | | | | | | | | D | | | | |
| | | | | | | | | 2.20m Hole Terminated at 2 20 m | | | | | | | |
| | | | | | | - | | | | | | | | | |
| | | | | 27.0 | 2.5 | | | | | | | | | | |
| 2 | | | | | | - | | | | | | | | | |
| 0.00.0 | | | | | | - | | | | | | | | | |
| 74.7 | | | | | | 1 | | | | | | | | | |
| 1071 | | | | 26.5 | 3.0 | 1 | | | | | | | | | |
| | | | | | | - | | | | | | | | | |
| b B | | | | | | - | | | | | | | | | |
| | | | | | | - | | | | | | | | | |
| 5 | | | | 26.0 | 3.5 | 1 | | | | | | | | | |
| | | | | |]] | | | | | | | | | | |
| 101 AA | | | | | | - | | | | | | | | | |
| | | | | | | - | | | | | | | | | |
| | | | | | | 1 | | | | | | | | | |
| | LEG | END: | - | | Notes, Sa | mples a | nd Tes | ts ter tube sample | <u> </u> | Consisten | erv Soft | | <u>U(</u> | CS (kPa 25 | a) Moisture Condition |
| | | धा Wat | er Level | | CBR | Bulk s | ample | for CBR testing | | S SC | oft | | 25 | 5 - 50 | M Moist |
| | _ | (Dat | te and time s | hown) | F | Enviro (Glas | onmenta s jar, se | a sample aled and chilled on site) | | F Fi | m iff | | 50 10 |) - 100)0 - 200 | W Wet W _p Plastic Limit |
| | | Wat Wat | er Inflow er Outflow | | ASS | Acid S (Plast | Sulfate S ic bag, | Soil Sample air expelled, chilled) | \ | /St Ve H Ha | ery Stiff ard | | 20 >4 | 00 - 400 100 | W _L Liquid Limit |
| 2 | <u>Stra</u> | ta Cha | anges | | B Field Too | Bulk S | Sample | · · · | - | Fb Fr | iable v | 1/4 | erv I o | IOSE | Density Index <15% |
| 2 | | Gi tra | radational or ansitional stra | ata | PID | Photo | ionisati | on detector reading (ppm) | | <u>- onony</u> | L | LC | oose | | Density Index 15 - 35% |
| | | — De sti | efinitive or di rata change | stict | HP | Hand | Penetro | ometer test (UCS kPa) | | | IVIL D VD | | eulurr ense | | Density Index 55 - 05% Density Index 65 - 85% Density Index 85 - 100% |

| | | | | E | INGI | NEE | RING LOG - TEST PIT | | TE | ST PI | t nc |): | TP13 |
|----------|-------------|-----------------------------------|--------------|------------------------|---------------------|-------------------------|---|--------------------------------------|-----------------------|------------------------|----------------|----------------------|---------------------------------------|
| | | | too | et 💋 o | LIENT | : 1 | MCCLOY GROUP | | PA | GE: | | | 1 OF 1 |
| | 0 | LABORATORY | I UUU | P | ROJE | CT: | PROPOSED SUBDIVISION | | JO | BNO | : | | NEW15P-0070 |
| | | Diboronom | 0.000 | 210 | | | | | LO | GGE |) BY | : | AAC |
| | | | | L | OCAT | ION: | STAGE 3 & 4 TERALBA | | DA | TE: | | | 22/6/15 |
| E | QUIP | | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE RL | .: 20 | 6.5 m | | | |
| | ESTF | IT LENGT | H: | 2.0 m | w | IDTH: | 0.6 m | DATUM: | As | ssume | ed | | |
| _ | Dr | lling and Sar | mpling T | | | 7 | Material description and profile info | ormation | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATIO SYMBOL | MATERIAL DESCRIPTION: Soil typ characteristics,colour,minor c | e, plasticity/particle components | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to mediu 0.15m brown, fines of low plasticity. Silty Clayey SAND - fine to mediu | Im grained, pale | | MD | | | |
| | | 0.40m | _ | | | - SM | 0.30m grey, fines of low plasticity. Sandy CLAY - medium plasticity, fine to medium grained. | pale brown, sand | | St | | | RESIDUAL SOIL |
| | | U50 | 26.0 | 0.5 | | | | | | | | | |
| | ered | 0.70m | - | | | | | | | | | | |
| ш | Encounte | 1 10m | 25.5 | 1.0 | | CI | Grading to pale grey with depth. | | М | | | | |
| | Not E | 1.1011 | | | | | | | | VSt | | | |
| | | 1.40m | | | | | | | | | | | |
| | | | 25. <u>0</u> | 1.5 | | | increasing sand with depth. | | | | | | |
| | | | | | | | <u>1.80m </u> | | _ | | | | |
| | | | 24.5 | 2.0 | | | SANDSTONE - fine to medium g extremely to highly weathered. | rained, pale grey, | D | н | | | WEATHERED ROCK |
| | | | | | | | Hole Terminated at 2.10 m | | | | | | |
| | | | | | | | | | | | | | |
| | | | 24.0 | 2.5 | | | | | | | | | |
| 2000 | | | | | | | | | | | | | |
| 0.0 41.4 | | | | | | | | | | | | | |
| 202 | | | 23.5 | 3.0 | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 23.0 | 3.5 | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | - | | | | | | | | | |
| | EGEND | : | · | Notes, Sa | Imples a 50mm | nd Tes Diame | t <u>s</u> ter tube sample | Consi VS | stency Verv Sof | t. | | CS (kPa 25 | a) Moisture Condition D Drv |
| | water Wa | ater Level | | CBR | Bulks | ample | for CBR testing | S E | Soft | - | 25 | 5 - 50 | M Moist |
| | (Da | ate and time s | shown) | E | (Glas | s jar, se | a sample aled and chilled on site) | St | Stiff | | 50 10 |)0 - 200 | W _p Plastic Limit |
| | -√a Wa | ater Outflow | | A55 | Acid S (Plast | ic bag, | son sample air expelled, chilled) | VSt H | very Stif Hard | ſ | 20 >4 | iu - 400 100 | v VV _L Liquid Limit |
| S | trata Cl | hanges Fradational or | | B <u>Field Te</u> s | Bulk S <u>ts</u> | Sample | | Fb Densi | Friable ty V | V | ery Lo | ose | Density Index <15% |
| | t | ransitional str | ata | PID DCP(x-v) | Photo | ionisati nic per | on detector reading (ppm) etrometer test (test depth interval shown) | | L | Lo D M | oose lediun | 1 Dense | Density Index 15 - 35% |
| | [| petinitive or di strata change | stict | HP | Hand | Penetro | ometer test (UCS kPa) | | D | | ense erv De | ense | Density Index 65 - 85% |

| (| | Q | LABORATORY | | | ENGI LIENT ROJE | NEE ∵ № CT: F | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION | | | te: Pa Jo Lo | st pi .ge: B no: .ggei | T NC : : : |): ': | TP14 1 OF 1 NEW15P-0070 AAC |
|-----------|--------------|--------------------------------------|---|--------------|---|--|--|---|---|--|---|---------------------------------|---|--|--|
| | | | | | L | OCAT | ION: S | STAGE 3 & 4 TERALBA | | | DA | TE: | | | 22/6/15 |
| E T | :QUI :ES1 | ipm T pi | IENT TYP T LENGTI | E: H: | Volvo 2.0 m | ECR2 | 35CL / IDTH: | 20T Excavator 0.6 m | SURFACE DATUM: | RL: | 22 As | 2.0 m ssume | ed | | |
| | | Drilli | ing and Sar | npling | | | | Material description and profile | e information | | 1 | | Fiel | d Test | |
| METHOD | | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soi characteristics,colour,min | l type, plasticity/part nor components | icle | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | | SM | Silty Clayey SAND - fine to m brown. | nedium grained, pale | e | м | MD | | | TOPSOIL / COLLUVIUM |
| | | | 0.40m | | | | | Sandy CLAY - medium plast fine to medium grained. | icity, pale brown, sa | nd | | St | | | RESIDUAL SOIL |
| | | ountered | B 0.60m | 21.5 | 5 0.5 0 1.0 | | | | | | M > W _P | | | | |
| ш | 1 | Not Enco | | 20.5 | 5 1.5 | | СІ | Becoming mottled red grey v lenses. | vith depth with irons | tone | M < Wp | VSt | | | |
| | | | | 20. <u>0</u> | 0 2.0 | | | 2.10m Hole Terminated at 2.10 m | | | | | | | |
| | | | | | | - | | | | | | | | | |
| arger cap | | | | 19.5 | 5 2. <u>5</u> | | | | | | | | | | |
| 200.000 | | | | | | | | | | | | | | | |
| 12.42 0. | | | | | | - | | | | | | | | | |
| | | | | 19. <u>0</u> |) 3. <u>0</u> | | | | | | | | | | |
| III III | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 10.00.00- | | | | 18.5 | <u>5</u> 3.5 | - | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| - 1001 | | | | | | | | | | | | | | | |
| | | ND: Wate (Date Wate Wate | er Level e and time s er Inflow er Outflow | hown) | Notes, Sa U ₅₀ CBR E ASS | 50mn 50mn Bulk s Envir (Glas Acid s (Plast Bulk s | n Diame sample f onmenta s jar, se Sulfate S tic bag, a | <u>s</u> ter tube sample or CBR testing I sample aled and chilled on site) toil Sample air expelled, chilled) | Co V S F S VS H c | e nsister S V S S Fi t S t S t V I H | ncy ery Soft oft irm tiff ery Stiff ard riable | | U 25 50 10 20 >4 | <u>CS (kPa</u> 25 5 - 50 0 - 100 00 - 200 00 - 400 400 | Moisture Condition D Dry M Moist W Wet Wpp Plastic Limit WL Liquid Limit |
| | <u></u> | Gr tra De str | radational or ansitional stra efinitive or dis rata change | ata stict | Field Test PID DCP(x-y) HP | Photo Dyna Hand | pionisatio mic pene Penetro | n detector reading (ppm) strometer test (test depth interval show meter test (UCS kPa) | n) | nsity | V L ME D VD | V La D M D | ery Lo bose lediun ense ery D | oose n Dense ense | Density Index <15% Density Index 15 - 35% e Density Index 15 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| | | | | E | ENGI | NEE | RING LOG - TEST PIT | | TE | ST PI | t nc |): | TP15 |
|---------------|---|---|--------------|-----------------|--------------------|--------------------------|--|--------------------------------------|---------------------|------------------------|----------------------------------|----------------------|---|
| C | | ENGINEERING LOG - TEST PIT TEST PIT NO: TP15 CLIENT: MCCLOY GROUP PAGE: 1 OF 1 PROJECT: PROPOSED SUBDIVISION JOB NO: NEW 15P-0070 | | | | | | | | | | | |
| | CLIENT: MCCLOY GROUP PAGE: 1 OF 1 PROJECT: PROPOSED SUBDIVISION JOB NO: NEW15P-0070 | | | | | | | | | | | | |
| | | EABORATORY | (NOW) FILL | | | | | | LO | GGEE |) BY | : | AAC |
| | | | | L | OCAT | ION: | STAGE 3 & 4 TERALBA | | DA | TE: | | | 22/6/15 |
| EC | UIPN | IENT TYP | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE RL: | 23 | 3.5 m | | | |
| TE | ST P | IT LENGT | H: | 2.0 m | w | IDTH | 0.6 m | DATUM: | As | ssume | ed | | |
| | Drill | ling and Sar | npling | | | 1 | Material description and profile info | ormation | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil typ characteristics,colour,minor o | e, plasticity/particle components | MOISTURE | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to mediu 0.15m brown, fines of low plasticity. | um grained, pale | - M | MD | | | |
| | | | | | 11 | SM | Silty Clayey SAND - fine to media 0.30m grey, fines of low plasticity. | um grained, pale | | | | | COLLUVIUM |
| | | 0.40m | 23.0 | | | | Sandy CLAY - medium plasticity, fine to medium grained. | pale brown, sand | | St | | | RESIDUAL SOIL |
| | ered | U50 | 20.0 | | | | | | | | 1 | | |
| ш | Encounte | 0.70m | | | | СІ | | | W _P | VSt | | | |
| | Not | | 22.5 | | | | | | × | | | | |
| | | 1.05m | 22.5 | 1.0 | | | | | | | | | |
| | | 050 1.15m | | | | · | 1.20m | | - | | | | |
| | | | | | | sc | Clayey SAND - fine to coarse gra brown, fines of low plasticity. | lined, pale grey | | н | | | |
| | | | 22. <u>0</u> | 1. <u>5</u> | | <u>1</u> | SANDSTONE - fine to medium g grey, highly weathered. | rained, pale brown | D | - | | | HIGHLY WEATHERED |
| | | | | | | | Hole Terminated at 1.60 m | | | | | | |
| | | | | | | | | | | | | | |
| | | | 21 5 | | - | | | | | | | | |
| 5 | | | 21.5 | 2.0 | - | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | 21.0 | 25 | - | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | - | | | | | | | | |
| 1 | | | | | - | | | | | | | | |
| | | | 20.5 | 3.0 | 1 | | | | | | | | |
| | | | |]] | | | | | | | | | |
| p | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| 5 | | | 20.0 | 3.5 | | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | 1 | | | | | | | | |
| | | | | Not 2 | | | | | | | <u> </u> | | |
| | JEND: ter | | | U ₅₀ | 50mn | n Diame | ter tube sample | VS V | /ery Soft | t | <u>U</u> <2 | 25 25 | D Dry |
| \mathbf{I} | Wat | ter Level | hours | CBR E | Bulk s Enviro | ample onment | tor CBR testing al sample | S 3 F 1 | Sott Firm | | 25 50 | o - 50) - 100 | M Moist W Wet |
| ► | (Dat – Wat | te and time s ter Inflow | nown) | ASS | (Glas Acid S | s jar, se Sulfate : | aled and chilled on site) Soil Sample | St St St | Stiff /ery Stiff | | 10 20 |)0 - 200)0 - 400 |) W _p Plastic Limit) W _L Liquid Limit |
| | Wat | ter Outflow | | в | (Plast Bulk 9 | ic bag, Sample | air expelled, chilled) | | -lard Friable | | >4 | 100 | |
| ັງ <u>ວນໃ</u> | <u>G</u> G | radational or | | Field Tes | <u>ts</u> Dhot- | ionic of | on detector reading (nom) | Density | V | V | ery Lo | ose | Density Index <15% |
| | tra — D st | ansitional stra efinitive or di rata change | ata stict | DCP(x-y) HP | Dynai Hand | mic per Penetro | etrometer test (test depth interval shown) ometer test (UCS kPa) | | L ME D VE | D M D D V | iose lediun ense erv De | n Dense | e Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| Q | 6 | LABORATORY | | | ENGI CLIENT PROJE | NEE :: ct: | RING LOG - TEST PIT MCCLOY GROUP PROPOSED SUBDIVISION | | TE PA JO | st pi .ge: .b no | т NC : |): | TP16 1 OF 1 NEW15P-0070 |
|----------|---|---|--------------|--|---|---|--|---|---|------------------------|---|---|---|
| | | | | L | OCAT | ION: | STAGE 3 & 4 TERALBA | | LO DA | GGEI TE: |) BY | : | AAC 22/6/15 |
| E(Ti | QUIPN EST P | MENT TYP IT LENGT | E: H: | Volvo 2.0 m | ECR2 | 35CL /IDTH | 20T Excavator 0.6 m | SURFACE RL: DATUM: | 39 As | 9.0 m ssume | ed | | |
| | Dril | lling and Sar | mpling | | | | Material description and profile info | rmation | | | Fiel | d Test | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MATERIAL DESCRIPTION: Soil type characteristics,colour,minor co | , plasticity/particle omponents | MOISTURE CONDITION | CONSISTENCY DENSITY | Test Type | Result | Structure and additional observations |
| | red | | | | 1313 | SM | 0.10m Silty Clayey SAND - low plasticity, | pale brown. | М | MD | | | |
| ш | Not Encounte | | 38.5 | | | CI | Sandy CLAY - medium plasticity, sand fine to coarse grained, with s medium grained gravel. | pale grey brown, some fine to | M < Wp | VSt | | | |
| | | | | - | | | SANDSTONE - fine to medium gr weathered. | ained, red, highly | | н | | | ROCK |
| | | | | | - | | Hole Terminated at 0.60 m Excavator Refusal | | | | | | |
| | | | 38. <u>0</u> | 1.0 | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | |] | | | | | | | | | |
| | | | 37.5 | 1.5 | | | | | | | | | |
| | | | | - | | | | | | | | | |
| | | | 37. <u>0</u> | 2.0 | - | | | | | | | | |
| 200 | | | | | - | | | | | | | | |
| 2 | | | | | - | | | | | | | | |
| | | | 36.5 | 2.5 | - | | | | | | | | |
| 1 | | | | | - | | | | | | | | |
| | | | 36.0 | 3.0 | | | | | | | | | |
| | | | - | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| | | | 35.5 | 3.5 | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | GEND: ater Wa (Da — Wa ■ Wa rata Ch | ter Level te and time s ter Inflow ter Outflow anges | hown) | <u>Notes, Sa</u> U₅ CBR E ASS B | amples a 50mn Bulk s Envir (Glas Acid s (Plas Bulk s | n Diame sample onment s jar, se Sulfate tic bag, Sample | its eter tube sample for CBR testing al sample saled and chilled on site) Soil Sample air expelled, chilled) | Consist VS S F St VSt H Fb | ency Very Soft Soft Firm Stiff Very Stiff Hard Friable | t 7 | U 25 50 10 20 >4 | CS (kPa 25 5 - 50 0 - 100 00 - 200 00 - 400 400 | a) <u>Moisture Condition</u> D Dry M Moist W Wet W _p Plastic Limit W _L Liquid Limit |
| | G tr D st | Gradational or ansitional stra Definitive or di trata change | ata stict | Field Tes PID DCP(x-y) HP | <u>ts</u> Photo Dyna Hand | oionisati mic per Penetr | on detector reading (ppm) netrometer test (test depth interval shown) ometer test (UCS kPa) | <u>Density</u> | V L MI D VF | | ery Lo oose lediun ense ery D | n Dense ense | Density Index <15% Density Index 15 - 35% Density Index 35 - 65% Density Index 65 - 85% Density Index 85 - 100% |

| | | | | E | INGI | NEE | RING LOG - TEST PIT | | TE | ST PI | r no |): | TP17 |
|----------------|-----------------|---------------------------|--------------|-------------------|--------------------|-------------------------|--|---------------------------------------|---------------------|------------------------|-----------|----------------------|--|
| C | | | tes | t 💆 c | LIENT | : 1 | MCCLOY GROUP | | PA | GE: | | | 1 OF 1 |
| | X | LABORATORY | INSWIPTY I | P | ROJE | CT: | PROPOSED SUBDIVISION | | JO | B NO: | | | NEW15P-0070 |
| | | | | | | | | | LO | GGEE |) BY | : | AAC |
| | | | | L | OCAT | ION: | STAGE 3 & 4 TERALBA | | DA | TE: | | | 22/6/15 |
| EQ | UIPN | | 'E: ⊔. | Volvo | ECR2 | 35CL | 20T Excavator | | .: 29 |).0 m | d | | |
| | | ling and Sar | n. | 2.0 111 | | | Matarial description and profile inf | DATONI. | A | sume | Eigh | d Toot | |
| | | | Inpilling | | | z | | ormation | | | | | |
| METHOD | WATER | SAMPLES | RL (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATIO SYMBOL | MATERIAL DESCRIPTION: Soil typ characteristics,colour,minor | oe, plasticity/particle components | MOISTURE | CONSISTENC) DENSITY | Test Type | Result | Structure and additional observations |
| | | | | | | SM | Silty Clayey SAND - fine to medi brown, pale grey. | um grained, pale | | | | | TOPSOIL |
| | | | | | | + | 0.20m Silty Clayey SAND - fine to medi | um grained, pale | —- м | MD | | | |
| | | 0.40m | | 1 - | 11 | SM | grey. | | _ | | | | |
| | | | 28.5 | 0.5 | | | Sandy CLAY - medium plasticity fine to medium grained. | , pale brown, sand | | | | | RESIDUAL SOIL |
| | | D | | | | | | | | | | | |
| | | 0.80m | | | | CI | | | | н | | | |
| | red | 0.00111 | | | | | | | | | | | |
| | ounte | | 28.0 | 1.0 | | <u> </u> | 1.00m | | | | | | |
| ш | Enco | | | | | | Silty Sandy CLAY - low to mediu sand fine to medium grained. (C | m plasticity, black, arbonaceous | | | | | ROCK |
| | Not | | | | | | Siltstone). | | Š | | | | |
| | | | | | | | | | × | | | | |
| | | | 27. <u>5</u> | 1.5 | | CL | | | | VSt/ | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | 27. <u>0</u> | 2.0_ | | <u> </u> | 2.00m | | | | | | |
| | | | | | | | brown, highly weathered. | grained, pale grey | | н | | | ROCK |
| | + | | | | | | Hole Terminated at 2.20 m | | | | | | |
| | | | |]] |] | | | | | | | | |
| 5 | | | 26. <u>5</u> | 2.5 | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| į | | | | | | | | | | | | | |
| | | | 26.0 | 3.0 | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| p | | | | |] | | | | | | | | |
| | | | | - | 4 | | | | | | | | |
| | | | 25.5 | 3.5 | - | | | | | | | | |
| | | | | | - | | | | | | | | |
| I | | | | - | | | | | | | | | |
| | | | | | 4 | | | | | | | | |
| LEC | GEND: | <u> </u> | | Notes. Sa | mples a | nd Tes | <u> </u> | Cons | stency | | U | | a) Moisture Condition |
| Wat | ter | | | | 50mn | n Diame | eter tube sample for CBR testing | VS | Very Sof | İ | <2 <2 | 25 5 - 50 | D Dry M Moist |
| \blacksquare | Wat | er Level te and time s | hown) | E | Enviro | onment | al sample | F | Firm | | 50 |) - 100 | W Wet |
| ► | - Wat | ter Inflow | | ASS | (Glas Acid S | s jar, se Sulfate \$ | aieu ana chillea on site) Soil Sample | St VSt | Stiff Very Stiff | : | 10 20 |)0 - 200)0 - 400 | VV _p Plastic Limit W _L Liquid Limit |
| Stra | I Wat ata Ch | er Outflow | | в | (Plast Bulk S | ic bag, Sample | air expelled, chilled) | H Fb | Hard Friable | | >4 | 400 | |
| | G | radational or | eta | Field Test PID | <u>ts</u> Photo | ionisati | on detector reading (ppm) | Densi | ty V | Ve | ery Lo | ose | Density Index <15% Density Index 15 - 35% |
| | tra D | efinitive or di | ata stict | DCP(x-y) | Dynai | nic pen | etrometer test (LICS kPa) | | M |) M | edium | n Dense | e Density Index 35 - 65% |
| | st | rata change | | | ianu | | | | VE |) Vi | erv De | ense | Density Index 85 - 100% |

| | | | | | E | INGI | NEE | RING LOG - TEST PIT | | | TE | ST PIT | r no |): | TP18 |
|-----------|--------------------|-------------|----------------------------|--------------|-------------------------|----------------------|---------------------|---|---------------------------------|-------------------------|-----------------------|--------------|-----------------|----------------------|---|
| | | | Indi | tas | t 🎾 o | LIENT | : 1 | MCCLOY GROUP | | | PA | GE: | | | 1 OF 1 |
| | | X | LABORATORY | INSWIPTY! | P | ROJE | CT: | PROPOSED SUBDIVISION | | | JO | B NO: | | | NEW15P-0070 |
| | | | 2 201101 | (1011) | | | | | | | LO | GGED |) BY | : | AAC |
| | | | | | L | OCATI | ON: | STAGE 3 & 4 TERALBA | | | DA | TE: | | | 22/6/15 |
| | EQ | UIPN | IENT TYP | E: | Volvo | ECR2 | 35CL | 20T Excavator | SURFACE F | RL: | 20 | .0 m | | | |
| | TES | ST PI | T LENGT | H: | 2.0 m | w | IDTH: | 0.6 m | DATUM: | | As | sume | d | | 1 |
| | | Drill | ing and Sar | npling | 1 | | 1 | Material description and profile info | rmation | | | | Field | d Test | |
| | Q | ~ | | | | <u></u> | L | | | | ₩S | , Y NC | ЭС | | Structure and additional |
| | ТНО | ATEF | SAMPLES | RL (m) | DEPTH | APH OG | IFICA MBO | MATERIAL DESCRIPTION: Soil type | e, plasticity/partio | cle | STUF | ISTE | t Typ | esult | observations |
| | ME | Ň | | (, | (, | GR GR | LASS | | | | QN CO | | Tes | œ | |
| - | | | | | | | O SM | Silty Clavey SAND - fine to coarse | e grained pale | | | | | | TOPSOIL |
| | | | | - | - | 3 3 -2-1-2-1 | | 0.13m brown, fines of low plasticity, som | e organics. | | М | MD | | | |
| | | | | - | | | , SIVI | <u>0.25m</u> <u>grey</u> , fines of low plasticity. | – — — — — — — | / | | | | | RESIDUAL SOIL |
| | | | 0.40m | | | | | Sandy CLAY - medium plasticity, sand fine to medium grained, with | pale grey brown some fine to | ١, | | | | | |
| | | | P | 19. <u>5</u> | 0.5 | | | medium grained gravel. | | | | | | | |
| | | | U50 | - | | | | | | | | | | | |
| | | | 0.7011 | - | | | CI | | | | × ≥ | VSt | | | |
| | | ered | | - | | | | | | | Σ | | | | |
| | | ounti | | 19. <u>0</u> | 1.0 | | | | | | | | | | |
| | ш | t Enc | | - | | | | Becoming pale grey brown with de | epth. | | | | | | |
| | | No | | - | | | | 1.30m | | | | | | | |
| | | | | - | | 0/0/0 | | Clayey Sandy GRAVEL - fine to c | oarse grained, p | pale | | | | | EXTREMELY WEATHERED CONGLOMERATE |
| | | | | 18.5 | 1.5 | / | | Slowin yollow. | | | | | | | |
| | | | | - | | 0/ 0/ 0 0/ 9/ | | | | | | | | | |
| | | | | - | - | °/ 9/ 0 | GC | | | | D | н | | | |
| | | | | - | | e e | | | | | | | | | |
| | | | | 18.0 | 2.0 | 66 | | | | | | | | | |
| 00 | | | | - | | 6 6 | , | | | | | | | | |
| | | | | | - | | | 2.20m Hole Terminated at 2.20 m | | | | | | | |
| an anu | | | | - | | 1 | | | | | | | | | |
| algel L | | | | 17.5 | 2.5 | - | | | | | | | | | |
| 200 | | | | - | | - | | | | | | | | | |
| 00.00 2 | | | | - | | - | | | | | | | | | |
| 4.7 | | | | - | - | 1 | | | | | | | | | |
| 107/10 | | | | 17. <u>0</u> | 3.0 |] | | | | | | | | | |
| | | | | - | - | - | | | | | | | | | |
| /IIIGFIIE | | | | - | - | - | | | | | | | | | |
| | | | | - | 1 - | 1 | | | | | | | | | |
| | | | | 16.5 | 3.5 |] | | | | | | | | | |
| n/nn | | | | - | | - | | | | | | | | | |
| | | | | - | | + | | | | | | | | | |
| Z | | | | - | - 1 | 1 | | | | | | | | | |
| | | | | | 1 | 1 | | | i | | | | | | |
| | LEG <u>W</u> at | END: er | | | <u>Notes, Sa</u> U₅₀ | mples a 50mm | nd Tes Diame | <u>ts</u> ter tube sample | Cor VS | n <u>sisten</u> S Ve | cy ery Soft | | <u>U(</u> <2 | CS (kPa 25 | a) <u>Moisture Condition</u> D Dry |
| | Ţ | Wat | er Level | 0 | CBR E | Bulk s Enviro | ample onment | for CBR testing al sample | S F | So Fir | oft m | | 25 50 | 5 - 50) - 100 | M Moist W Wet |
| UREL V | - | (Dat Wat | te and time s er Inflow | hown) | 466 | (Glass | s jar, se | aled and chilled on site) | St | Sti | iff arv Stiff | | 10 | 0 - 200 | W _p Plastic Limit |
| | | Wat | er Outflow | | -00 | (Plast | ic bag, | air expelled, chilled) | H | Ha | ard | | 20 >4 | ,0 - 400 100 | |
| Cog | <u>Stra</u> | ta Cha | anges radational or | | B Field Test | Bulk S t <u>s</u> | sample | | Fb Der | Fri nsity | able V | Ve | ery Lo | ose | Density Index <15% |
| | | tra | ansitional stra | ata | PID DCP(x-v) | Photo Dynar | ionisati nic pen | on detector reading (ppm) etrometer test (test depth interval shown) | | | L ME | Lo M | oose edium | n Dense | Density Index 15 - 35% Density Index 35 - 65% |
| | | sti | rata change | Guot | HP | Hand | Penetro | ometer test (UCS kPa) | | | D VD | De | ense erv De | ense | Density Index 65 - 85% Density Index 85 - 100% |

APPENDIX B:

Results of Laboratory Testing



| Californ | nia Bearing Ratio Te | est Report | Report No: CBR:NEW15V | /-1297S01 Issue No: 1 |
|---|---|----------------------|---|--|
| Client: Principal: Project No.: Project Name: | McCLOY GROUP Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 NEW15P-0070 Proposed Subdivision - Stage 3 & 4, Te | eralba | Accredited for compliance with IS The results of the tests, calibration measurements included in this do to Australian/national standards Approved Signatory: Dane Cullen (Senior Geotechnician) NATA Accredited Laboratory Nun Date of Issue: 1/07/2015 | O/IEC 17025 ns and/or curnent are traceabl nber18686 |
| Sample Det Sample ID: Client ID: Date Sampled: Sampling Meth Specification: Location: Date Tested: | ails NEW15W-1297S01 22/06/2015 od: AS1289.1.2.1 cl 6.5.4 No Specification TP4 - (0.4 - 0.6m) 30/06/2015 | Source: Material: | On-Site Sandy Clay | |
| Load vs Pe | netration | | Test Results | 4.0 1.55 23.5 1.54 100 23.5 100 1.50 97 2.5 34.1 27.6 Standard 9.00 4 0.0 23.1 |

Form No: 18986, Report No: CBR:NEW15W-1297--S01

Moisture Content Method Performed as Per AS1289.2.1.1.



Report No: CBR:NEW15W-1297--S02

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Issue No: 1 California Bearing Ratio Test Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards NATA Principal: NEW15P-0070 Project No .: Approved Signatory: Dane Cullen Project Name: Proposed Subdivision - Stage 3 & 4, Teralba (Senior Geotechnician) WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 1/07/2015 Sample Details Sample ID: NEW15W-1297--S02 Client ID: Date Sampled: 22/06/2015 Sampling Method: AS1289.1.2.1 cl 6.5.4 Specification: **On-Site** No Specification Source: Location: TP5 - (0.5 - 0.8m) Material: Sandy Clay 30/06/2015 Date Tested: **Test Results** Load vs Penetration AS 1289.6.1.1 CBR At 2.5mm (%): 4.0 1.5 Maximum Dry Density (t/m3): 1.64 1.4 Optimum Moisture Content (%): 21.7 Dry Density before Soaking (t/m³): 1.64 13 Density Ratio before Soaking (%): 100 12 Moisture Content before Soaking (%): 21.6 Moisture Ratio before Soaking (%): 99 1 1 Dry Density after Soaking (t/m³): 1.62 1.0 Density Ratio after Soaking (%): 99 Load on Piston (kN) Swell (%): 1.0 0 9 28.7 Moisture Content of Top 30mm (%): 0.8 Moisture Content of Remaining Depth (%): 22.9 Compactive Effort: Standard 0.7 Surcharge Mass (kg): 9.00 0.6 Period of Soaking (Days): 4 Oversize Material (%): 0.0 0.5 0.4 - Moisture Content -Field Moisture Content (%): 20.3 03 0.2 0.1 0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 Penetration (mm)

Comments



| Califorr | nia Bearing Ratio T | est Report | Report No: CBR:NEW15W | /-1297S0 Issue No: |
|--|--|----------------------|---|--|
| Client: Principal: Project No.: Project Name: | McCLOY GROUP Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 NEW15P-0070 Proposed Subdivision - Stage 3 & 4, T | eralba | Accredited for compliance with IS The results of the tests, calibration measurements included in this do to Australian/national standards Accredited For compliance with IS The results of the tests, calibration measurements included in this do to Australian/national standards Approved Signatory: Dane Cullen (Senior Geotechnician) NATA Accredited Laboratory Num Date of Issue: 1/07/2015 | O/IEC 17025 Is and/or cument are tracea |
| Sample De Sample ID: Client ID: Date Sampled: Sampling Meth Specification: Location: Date Tested: | 22/06/2015 22/06/2015 aod: AS1289.1.2.1 cl 6.5.4 No Specification TP12 - (0.5 - 0.8m) 30/06/2015 | Source: Material: | On-Site Sandy Clay | |
| Load vs Pe | netration | | Test Results | 3.5 1.53 26.4 1.53 100 26.3 100 1.51 99 1.0 35.3 27.8 Standard 9.00 4 0.0 |

Comments



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Comments



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Report No: CBR:NEW15W-1297--S12 California Bearing Ratio Test Report Issue No: 1 Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: NEW15P-0070 Project No .: Approved Signatory: Dane Cullen Project Name: Proposed Subdivision - Stage 3 & 4, Teralba (Senior Geotechnician) WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 1/07/2015 Sample Details Sample ID: NEW15W-1297--S12 Client ID: Date Sampled: 22/06/2015 Sampling Method: AS1289.1.2.1 cl 6.5.4 Specification: **On-Site** No Specification Source: Location: TP17 - (0.4 - 0.8m) Material: Sandy Clay 30/06/2015 Date Tested: **Test Results** Load vs Penetration AS 1289.6.1.1. 40+... CBR At 5.0mm (%): 7 Maximum Dry Density (t/m3): 1.82 Optimum Moisture Content (%): 14.6 Dry Density before Soaking (t/m³): 1.81 Density Ratio before Soaking (%): 100 Moisture Content before Soaking (%): 14.7 3.0 Moisture Ratio before Soaking (%): 100 Dry Density after Soaking (t/m³): 1.81 Density Ratio after Soaking (%): 100 oad on Piston (kN) Swell (%): 0.0 19.8 Moisture Content of Top 30mm (%): 20 Moisture Content of Remaining Depth (%): 16.1 Compactive Effort: Standard Surcharge Mass (kg): 9.00 Period of Soaking (Days): 4 Oversize Material (%): 0.0 1.0 - Moisture Content -Field Moisture Content (%): 15.1 0.0 7.0 1.0 2.0 3.0 4.0 5.0 6.0 8.0 9.0 10.0 11.0 12.0 13.0 0.0 Penetration (mm)

Comments



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Comments



Report No: SSI:NEW15W-1297--S05

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Issue No: 1 Shrink Swell Index Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S05 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP9 - (0.4 - 0.7m) Sample Location: Borehole Number: TP9 Borehole Depth (m): 0.4 - 0.7m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test Swell on Saturation (%): 0.5 Shrink on drying (%): 7.1 29.5 Shrinkage Moisture Content (%): 30.2 Moisture Content before (%): Est. inert material (%): Moisture Content after (%): 31.6 0 Est. Unc. Comp. Strength before (kPa): 250 Crumbling during shrinkage: 0 Est. Unc. Comp. Strength after (kPa): Cracking during shrinkage: Nill 150 Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 4.1



Report No: SSI:NEW15W-1297--S06

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Issue No: 2 Shrink Swell Index Report his report replaces all previous issues of report no 'SSI:NEW15W-1297--S06' Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S06 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP11 - (0.5 - 0.8m) Sample Location: Borehole Number: **TP11** Borehole Depth (m): 0.5 - 0.8m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test Swell on Saturation (%): -0.4 Shrink on drying (%): 2.9 22.2 Shrinkage Moisture Content (%): 21.9 Moisture Content before (%): Moisture Content after (%): 22.5 Est. inert material (%): 1 0 Est. Unc. Comp. Strength before (kPa): 450 Crumbling during shrinkage: Est. Unc. Comp. Strength after (kPa): 400 Cracking during shrinkage: Minor Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 1.6



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Report No: SSI:NEW15W-1297--S08 Issue No: 1 Shrink Swell Index Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S08 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP13 - (0.4 - 0.7m) Sample Location: Borehole Number: TP13 Borehole Depth (m): 01.4 - 0.7m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test 2.0 Swell on Saturation (%): -0.3 Shrink on drying (%): 17.0 Shrinkage Moisture Content (%): 16.6 Moisture Content before (%): Moisture Content after (%): 20.9 Est. inert material (%): 0 Est. Unc. Comp. Strength before (kPa): 250 Crumbling during shrinkage: 0 Est. Unc. Comp. Strength after (kPa): 200 Cracking during shrinkage: Nill Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 1.1



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Report No: SSI:NEW15W-1297--S09 Issue No: 1 Shrink Swell Index Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S09 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP13 - (1.1 - 1.4m) Sample Location: Borehole Number: TP13 Borehole Depth (m): 1.1 - 1.4m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test Swell on Saturation (%): 0.3 Shrink on drying (%): 0.9 Shrinkage Moisture Content (%): 12.9 Moisture Content before (%): 13.5 Moisture Content after (%): 16.2 Est. inert material (%): 0 Est. Unc. Comp. Strength before (kPa): 600+ 0 Crumbling during shrinkage: Est. Unc. Comp. Strength after (kPa): 550 Cracking during shrinkage: Minor Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 0.6



Report No: SSI:NEW15W-1297--S11

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Issue No: 1 Shrink Swell Index Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S11 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP15 - (0.4 - 0.7m) Sample Location: Borehole Number: TP15 Borehole Depth (m): 0.4 - 0.7m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test Swell on Saturation (%): -0.7 Shrink on drying (%): 3.6 27.3 Shrinkage Moisture Content (%): 27.5 Moisture Content before (%): Moisture Content after (%): 27.3 Est. inert material (%): 1 Crumbling during shrinkage: 0 Est. Unc. Comp. Strength before (kPa): 500 Est. Unc. Comp. Strength after (kPa): 300 Cracking during shrinkage: Nill Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 2.0



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Report No: SSI:NEW15W-1297--S14 Issue No: 1 Shrink Swell Index Report Accredited for compliance with ISO/IEC 17025 Client: McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ Principal: Project No.: NEW15P-0070 Approved Signatory: Alan Cullen (Principal Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 3/07/2015 Sample Details Sample ID: NEW15W-1297--S14 Client Sample ID: Test Request No .: Sampling Method: AS1289.1.2.1 cl 6.5.4 Material: Sandy Clay Date Sampled: 22/06/2015 Source: On-Site Date Submitted: 24/06/2015 Specification: No Specification Project Location: Pitt Street, Teralba TP18 - (0.4 - 0.7m) Sample Location: Borehole Number: TP18 Borehole Depth (m): 0.4 - 0.7m AS 1289.7.1.1 AS 1289.7.1.1 Shrink Test Swell Test Swell on Saturation (%): -0.1 Shrink on drying (%): 1.7 22.1 Shrinkage Moisture Content (%): 22.5 Moisture Content before (%): Moisture Content after (%): 26.1 Est. inert material (%): 5 Est. Unc. Comp. Strength before (kPa): 600+ 0 Crumbling during shrinkage: Major Est. Unc. Comp. Strength after (kPa): 350 Cracking during shrinkage: Shrink Swell Shrinkage Sw ell 10.0 Shrink (%) Esh - Swell (%) Esw 5.0 0.0 -5.0 -10.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 5.0 45.0 50.0 Moisture Content (%) Shrink Swell Index - Iss (%): 0.9



| Material Test Report | Report No: MAT:NEW15W-1297S03 Issue No: 1 |
|---|--|
| Client: McCLOY GROUP Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 Principal: Project No.: NEW15P-0070 Project Name: Proposed Subdivision - Stage 3 & 4, Teralba | 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 WORLD RECOGNISED Approved Signatory: Dane Cullen (Senior Geotechnician) NATA Accredited Laboratory Number18686 Date of Issue: 1/07/2015 |
| Sample DetailsSample ID:NEW15W-1297S03Sampling Method:AS1289.1.2.1 cl 6.5.4Date Sampled:22/06/2015Source:On-SiteMaterial:Sandy ClaySpecification:No SpecificationProject Location:Pitt Street, TeralbaSample Location:TP6 - (0.4 - 0.8m) | Particle Size Distribution |
| Other Test ResultsDescriptionMethodResultLimitsSample HistoryAS 1289.1.1Air-driedPreparationAS 1289.1.1Dry SievedLinear Shrinkage (%)AS 1289.3.4.12.5Mould Length (mm)250CrumblingNoCurlingNoCrackingYesLiquid Limit (%)AS 1289.3.1.119MethodFour PointPlastic Limit (%)AS 1289.3.2.112Plasticity Index (%)AS 1289.3.3.17 | Chart |
| Comments N/A | |



| | | | Report No: MAT:NEW15W-1297S04 |
|-----------------------------|---------------------------------------|---------|---|
| Material Tes | t Report | | Issue No: 1 |
| | | | Accordited for compliance with ISO/IEC 17025 |
| Client: McCLO Suite 1 | Y GROUP Level 3, 426 King Street | | The results of the tests, calibrations and/or |
| Newcas | tle West NSW 2300 | | to Australian/national standards |
| | | | NATA |
| Principal: | | | N / D (22 |
| Project No.: NEW15 | P-0070 | | Approved Signatory: Dane Cullen |
| Project Name: Propose | ed Subdivision - Stage 3 & 4, Teralba | | WORLD RECOONIBED (Senior Geotechnician) ACCREDITATION NATA Accredited Laboratory Number18686 |
| | | | Date of Issue: 1/07/2015 |
| Sample Details | | | Particle Size Distribution |
| Sample ID: | NEW15W-1297S04 | | |
| Sampling Method: | AS1289.1.2.1 cl 6.5.4 | | |
| Date Sampled: | 22/06/2015 | | |
| Source: | On-Site | | |
| Material: Specification: | Sandy Clay | | |
| Project Location: | Pitt Street. Teralba | | |
| Sample Location: | TP7 - (0.4 - 0.7m) | | |
| | , | | |
| | | | |
| | | | |
| Other Test Results | 2 | | |
| Description | Method Result | Limite | |
| Sample History | AS 1289.1.1 Air-dried | Liiiits | - |
| Preparation | AS 1289.1.1 Dry Sieved | | |
| Linear Shrinkage (%) | AS 1289.3.4.1 6.5 | | |
| Mould Length (mm) | 250 | | |
| | No | | |
| Cracking | INU Yes | | |
| Liquid Limit (%) | AS 1289.3.1.1 56 | | |
| Method | Four Point | | |
| Plastic Limit (%) | AS 1289.3.2.1 16 | | |
| Plasticity Index (%) | AS 1289.3.3.1 40 | | - |
| | | | |
| | | | Chart |
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| | | | |
| Commonte | | | |
| N/A | | | |
| | | | |
| | | | |



| Material Test Rep | oort | | | Report | t No: MAT:NEW15W-1297S12 Issue No: 1 |
|--|--|------------------|--------|--------------|---|
| Client: McCLOY GROUP Suite 1, Level 3, 42 Newcastle West N | 26 King Street ISW 2300 | | | | 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 |
| Principal: Project No.: NEW15P-0070 Project Name: Proposed Subdivis | ion - Stage 3 & 4 | l, Teralba | | | Approved Signatory: Dane Cullen (Senior Geotechnician) NATA Accredited Laboratory Number18686 Date of Issue: 1/07/2015 |
| Sample Details | | | | Particle Siz | e Distribution |
| Sample ID: NEW15W Sampling Method: AS1289.1 Date Sampled: 22/06/201 Source: On-Site Material: Sandy Cla Specification: No Specif Project Location: Pitt Street Sample Location: TP17 - (0 | -1297512 .2.1 cl 6.5.4 5 ay fication t, Teralba .4 - 0.8m) | | | | |
| Other Test Results | | | | | |
| Description | Method | Result | Limits | _ | |
| Moisture Content (%) | AS 1289.2.1.1 | <u>15.1</u> | | - | |
| Preparation | AS 1209.1.1 AS 1280.1.1 | Dry Sieved | | | |
| Linear Shrinkage (%) | AS 1289.1.1 AS 1289.3.4.1 | 5 0 | | | |
| Mould Length (mm) | 10 1200101 111 | 250 | | | |
| Crumbling | | No | | | |
| Curling | | Yes | | | |
| Cracking | | No | | | |
| Liquid Limit (%) | AS 1289.3.1.1 | 36 | | | |
| Method | | Four Point | | | |
| Plastic Limit (%) | AS 1289.3.2.1 | 17 | | | |
| Standard Maximum Dry Density (t/m ³) | AS 1209.3.3.1 | 1.82 | | - | |
| Standard Optimum Moisture Content (%) | | 14.5 | | Chart | |
| Retained Sieve 19.0mm (%) | | 0 | | | |
| Compactive Effort | | Standard | | | |
| CBR At 5.0mm (%) | AS 1289.6.1.1 | 7 | | - | |
| Maximum Dry Density (t/m ³) | | 1.82 | | | |
| Optimum Moisture Content (%) | | 14.6 | | | |
| Density Ratio before Soaking (V/M ³) | | 1.01 | | | |
| Moisture Content before Soaking (%) | | 14 7 | | | |
| Moisture Ratio before Soaking (%) | | 100 | | | |
| Dry Density after Soaking (t/m ³) | | 1.81 | | | |
| Density Ratio after Soaking (%) | | 100 | | | |
| Swell (%) | | 0.0 | | | |
| Moisture Content of Top 30mm (%) | | 19.8 | | | |
| Involution Content of Remaining Depth (%) | | 16.1 Standard | | | |
| Surcharge Mass (kg) | | 9.00 | | | |
| | | | | <u> </u> | |

N/A



Client:

Principal:

Project No.:

Sample ID:

Source:

Material:

Description

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

Report No: MAT:NEW15W-1297--S12 Issue No: 1 Accredited for compliance with ISO/IEC 17025 McCLOY GROUP The results of the tests, calibrations and/or measurements included in this document are traceable Suite 1, Level 3, 426 King Street Newcastle West NSW 2300 to Australian/national standards ΝΑΤΑ all NEW15P-0070 Approved Signatory: Dane Cullen (Senior Geotechnician) Project Name: Proposed Subdivision - Stage 3 & 4, Teralba WORLD RECOGNISED NATA Accredited Laboratory Number18686 Date of Issue: 1/07/2015 Sample Details Particle Size Distribution NEW15W-1297--S12 Sampling Method: AS1289.1.2.1 cl 6.5.4 Date Sampled: 22/06/2015 **On-Site** Sandy Clay Specification: No Specification Project Location: Pitt Street, Teralba Limits Sample Location: TP17 - (0.4 - 0.8m) Other Test Results Method Result Limits Period of Soaking (Days) 4 Oversize Material (%) 0.0 Chart

Material Test Report

APPENDIX C:

Results of Previous Investigations by Cardno Geotech Solutions (Ref: CGS1785, dated 19 December 2014)

Test Pit Logs & Results of Laboratory Testing

| PRO | JECT : ATION · | Geote | chnical treet Ti | Inve: eralh | stigation | | | | | | PF S⊢ | ROJECT REF : CGS1785 |
|-------------------------|--|--------------------|---|-----------------------------------|---|--|---|----------------------------|--|--|---|---|
| EQU | IPMENT | TYPE | : 20t E | Exca | vator | | METHOD : 800 | mm too | thed bu | icket | 0.1 | |
| DATE | E EXCA | /ATEC |): 28/1 | 1/14 | | | LOGGED BY : | DS | | | CHECK | ED BY : ZO |
| LOC | ATION : | See I | Drawing | for l | ocation | | | | | | | |
| ROUND WATER LEVELS | SAMPLES & IELD TESTS | DEPTH (m) | GRAPHIC LOG | LASSIFICATION SYMBOL | MATE Soil Type, plasticit Rock T Secondar | RIAL DESCRIPTION y or particle characteristic, ype, grain size, colour y and minor components | colour | MOISTURE / WEATHERING | CONSISTENCY / REL DENSITY / OCK STRENGTH | DYNAMIC ENETROMETER | 0 HAND 0 PENETRO- 0 METER (kPa) | STRUCTURE & Other Observations |
| 9 pe | <u>оц</u> | 0.0 | २० २० २० २.२० २० २० २.१० २० २.१० ४० २० इ.१० ४० ४० | 0 | TOPSOIL, Clayey SAND, fi and organics | ine to coarse grained, grey- | brown, with gravel | D | 0-2 | ä | +00 +00 +00 +00 +00 +00 +00 +00 +00 +00 | |
| ot Encountere | | | <u>6 36 36 36</u> | | 0.15m SANDSTONE, fine to coars | se grained, orange-red | | | | - | | |
| z | | - | | | 0.40m | | | XW - DW | M - H | | | |
| | | 0.5- | | | Testpit TP201 terminated a Refusal | at 0.40 m | | | | | | |
| | | - | | | | | | | | | | |
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| | | 1.5 | | | | | | | | | | |
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| | | - | | | | | | | | | | |
| | | 2.0 | | | | | | | | | | |
| D M W ON PL | ATER / MC - Dry - Mois - Wet MC - Opti - Plas - Wa | DISTURI | | SAMI D ES B SPT HP | PLES & FIELD TESTS Undisturbed Sample Disturbed Sample Forvironmental sample Sult Disturbed Sample Standard Penetration Test Hand/Pocket Penetrometer | CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard | RELATIVE DEN VL - Very Loo L - Loose MD - Medium I D - Dense VD - Very Den | SITY se Dense Ise | RO EL VL M H VH EH | CK ST - Ex - Ve - Lo - Me - Hių - Ve - Ex | RENGTH tremely low ry low w dium gh gh ry high tremely high | ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock |
| See I detai & bas | Explanate ils of abbi sis of des | ory Not eviatio | es for ns ns. | | CAR | DNO GEOTE | ECH SOLL | ΙΟΙΤΙ | NS | | | |

CLIENT : McCloy Group Pty Ltd

HOLE NO : TP201

| CLIENT : McCloy Group Pty Ltd |
|--------------------------------------|
| PROJECT : Geotechnical Investigation |

HOLE NO : TP203 PROJECT REF : CGS1785

LOCATION : Pitt Street, Teralba

GEOTECH_SOLUTIONS_03 LIBRARY GLB_L09_CGS_TESTHOLE_LOG_02_CGS_1785_PITT_STREET_TERALBA GPJ_17/12/2014 19:12_8:30.004

EQUIPMENT TYPE : 20t Excavator

DATE EXCAVATED : 28/11/14 LOCATION : See Drawing for location

METHOD : 800mm toothed bucket LOGGED BY : DS

SHEET : 1 OF 1

CHECKED BY : ZO

| GROUND WAIEK LEVELS | SAMPLES & FIELD TESTS | DEPTH (m) | GRAPHIC | CLASSIFICATION SYMBOL | MATEF Soil Type, plasticity Rock Ty Secondary | RAL DESCRIPTION or particle characteristic, pe, grain size, colour and minor components | colour | MOISTURE / WEATHERING | CONSISTENCY / REL DENSITY / ROCK STRENGTH | DYNAMIC | 100 HAND 200 PENETRO- 300 METER 100 (kPa) | STRUCTURE & Other Observations |
|------------------------|---|--|--|--|--|---|--|---------------------------|---|--|--|---|
| - | | - 0.0 | त. कर के त. कर के त. कर के त. कर के त. कर के त. कर के त. कर के | 전 | TOPSOIL, Clayey SAND, fir and organics | e to coarse grained, grey- | prown, with gravel | D | L | | | |
| | | - | | | Sandy CLAY, medium plasti | city, grey-orange mottled n | ed | MC < PL | | | | |
| Not Encountered | 0.40m B | 0.5 | | · · · · · · · · · · · · · · · · · · · | SANDSTONE / SILTSTONE | (interbedded), fine graine | d, grey-orange | | | | | - |
| | | 1.0 | | | | | | XW - DW | М | | | - |
| | | - 1.5 | | · · · · · · · · · · · · | 1.50m Testpit TP203 terminated at Refusal | 1.50 m | | | | | | |
| | | - | | | | | | | | | | |
| | ATER / MC - Dry - Mois - Wet //C - Opti - Plas | DISTURI st t imum M stic Limit ter inflov | E C t | SAM U D ES B SPT HP | PLES & FIELD TESTS - Undisturbed Sample - Disturbed Sample - Environmental sample - Bulk Disturbed Sample - Standard Penetration Test - Hand/Pocket Penetrometer | CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard | RELATIVE DEN: VL - VeryLoo L - Loose MD - Medium I D - Dense VD - VeryDen | SITY se Dense se | RO EL VL M H VH EH | - Extr - Ven - Low - Mec - High - Ven - Extr | RENGTH remely low y low f dium h y high remely high | ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Districtly weathered SW - Slightly weathered FR - Fresh rock |
| See deta & ba | Explanato Is of abbr sis of des | ory Not reviatio scriptio | tes for ins ns. | r | CARI | ONO GEOTE | CH SOLL | ITION | ١S | | | |

| EQU | | | : 20t I | | /ator | | | METHOD : 800 | mm too | thed bu | icket | | |
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| LOC | CATION : | See I | Drawing | for lo | ocatio | n | | LUGGED BY : | 05 | | | CHECK | ED BY : 20 |
| | | 2001 | | | | | | | | | | | |
| GROUND WATER LEVELS | SAMPLES & FIELD TESTS | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | | MATEF Soil Type, plasticity Rock Ty Secondary | RIAL DESCRIPTION or particle characteristic, rpe, grain size, colour or and minor components | colour | MOISTURE / WEATHERING | CONSISTENCY / REL DENSITY / ROCK STRENGTH | DYNAMIC PENETROMETER | 100 HAND 200 PENETRO- 300 METER 400 (KPa) | STRUCTURE & Other Observations |
| | | 0.0 | रेन के क्व र. का का क का का का इ. का का क हे का का क | | | TOPSOIL, Gravelly Clayey with organics | SAND, fine to coarse grain | ed, grey-brown, | D | | | | |
| | | - | | | 0.15m | Sandy CLAY, low to medium | n plasticity, grey-orange m | ottled red | MC < PL | | | | |
| | | - | · · · · · · · · | | 0.2011 | SANDSTONE, fine grained, | grey-orange | | | | | | |
| countered | | - | | | | | | | | | | | |
| Not End | | 0.5 — | | | | | | | | | | | - |
| | | - | | | | | | | XW - DW | М | | | |
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| | | - | | | | | | | | | | | |
| | | 1.0 — | | | 1.00m | Testpit TP205 terminated at Refusal | t 1.00 m | | | | | | |
| .30.004 | | - | | | | | | | | | | | |
| /2014 19:12 8 | | - | | | | | | | | | | | |
| BA.GPJ 17/12 | | - | | | | | | | | | | | |
| TREET_TERAI | | 1.5 — | | | | | | | | | | | - |
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| 06_02 CGS | | - | | | | | | | | | | | |
| TESTHOLE_L | | - | | | | | | | | | | | |
| B Log CGS | | 2.0 | | | | | | | | | | | |
| SOLUTIONS_03 LIBRARY.GL | VATER / MC - Dry 1 - Mois V - Wet MC - Opti L - Plas Wat | nisturi st mum M stic Limit ser inflov | | SAMF U D ES B SPT HP | PLES 8 - Und - Dist - Env - Bull - Star - Han | FIELD TESTS listurbed Sample urbed Sample ironmental sample Disturbed Sample ndard Penetration Test d/Pocket Penetrometer | CONSISTENCY VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard | RELATIVE DEN VL - Very Loo L - Loose MD - Medium D - Dense VD - Very Der | SITY se Dense ise | RO EL VL M H VH EH | - Ex - Ve - Lo - Me - Mi - Hi - Ve - Ex | RENGTH Atremely low ery low w edium gh ery high tremely high | ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock |
| See deta & b | Explanate ails of abbr asis of des | ory Not eviatio criptio | es for ns ns. | | | CAR | DNO GEOTE | ECH SOLU | IOITI | NS | | | · |

CLIENT : McCloy Group Pty Ltd PROJECT : Geotechnical Investigation

LOCATION : Pitt Street, Teralba

HOLE NO : TP205 PROJECT REF : CGS1785 SHEET : 1 OF 1

| CLIENT | ÷ | McClov Group Ptv Ltd | |
|--------|---|----------------------|--|
| | • | | |

HOLE NO : TP206 PROJECT REF : CGS1785

CHECKED BY : ZO

PROJECT : Geotechnical Investigation LOCATION : Pitt Street, Teralba

EQUIPMENT TYPE : 20t Excavator

METHOD : 800mm toothed bucket

DATE EXCAVATED : 28/11/14

LOGGED BY : DS

SHEET : 1 OF 1

| 100 | LATION | See | Ura | wing | for | loca | ntion | | | | | | | | |
|------------------------|---|---|---|--|---------------------------------------|---|---|--|---|-----------------------------------|---|---|--|-------------------------------|---|
| GROUND WATER LEVELS | SAMPLES & FIELD TESTS | DEPTH (m) | Онарар | LOG | CLASSIFICATION SYMBOL | | MATE Soil Type, plasticity Rock Ti Secondary | RIAL DESCRIPTION y or particle characteristic, ype, grain size, colour y and minor components | colour | MOISTURE / WEATHERING | CONSISTENCY / REL DENSITY / ROCK STRENGTH | DYNAMIC PENETROMETER | 100 HAND 200 PENETRO- | 300 METEK 400 (kPa) | STRUCTURE & Other Observations |
| | | - 0.0 - | <u>80</u> 20 20 20 20 20 20 20 20 20 20 20 20 20 | 00.00 20.20 70.40 70.40 70.40 70.40 20.40 20.40 | | | TOPSOIL, Gravelly Clayey with organics | SAND, fine to coarse grain | ed, grey-brown, | D | | | | | |
| | | | | 1 | | 0.15 | 5m Gravelly Sandy CLAX med | ium plasticity, grav-orange | mottled red | | | - | | | |
| | | | V | | | | | ian plasticity, grey orange | motica rea | MC < PL | | | | | |
| | | | | | | 0.30 |)m | | | | | | | | |
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| | | 1.5 - | | <u>-</u> . | | 1.50 | Dm Testpit TP206 terminated a | t 1.50 m | | | | | | | |
| | | | | | | | Refusal | | | | | | | | |
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| | | 20 | | | | | | | | | | | | | |
| | | 2.0- | | | | | | | | | | | | | |
| | VATER / MO) - Dry 1 - Moi V - We DMC - Opt PL - Pla Wa | DISTUR st t imum M stic Limi ter inflo | E 1C it w | | SAM U D ES B SPT HP | PLES - U - E - E - S - S | S & FIELD TESTS Jndisturbed Sample Disturbed Sample Environmental sample Julk Disturbed Sample Standard Penetration Test Hand/Pocket Penetrometer | CONSISTENCYVS- Very SoftS- SoftF- FirmSt- StiffVSt- Very StiffH- Hard | RELATIVE DEN VL - Very Loo L - Loose MD - Medium D - Dense VD - Very Der | SITY se Dense nse | RO EL VL M H VH EH | - E) - Ve - Ve - Lo - M - Hi - Ve - E) | TRENG tremely ery low w edium gh ery high tremely | r H / low / high | ROCK WEATHERING RS - Residual soil XW - Extremely weathered DW - Distinctly weathered SW - Slightly weathered FR - Fresh rock |
| See deta & ba | e Explanat ails of abb asis of de | ory No reviatio | tes ons ns. | for | | | CAR | DNO GEOTE | ECH SOLL | ITIO | NS | | | | |



Cardno (NSW/ACT) Pty Ltd trading as Cardno Geotech Solutions ABN 95 001 145 035 P.O Box 4224, Edgeworth 2285 Unit 4/5 Arunga Dr, Beresfield 2322 [P] 0249 494300 [F] 0249 660485 [E] geotech@cardno.com.au

| | | | | | | Ca | lif | orr | nia | Be | ari | ing | Ra | atio | D R | ер | ort | : (1 | . P | oint | t) | | | | | | | |
|-------------------------------------|--|-----------------|-------------------------|------------------------|-----------------|-----------------|--------------------------|------|-----|-------|-----|----------|-----------|-----------------|-----------------------------------|---------------|-------------------|-----------------|-----------------|--------------|------------------------|--------|--------------|--------|----------|------------------|----------------|--|
| Client: Client addi Job Numbe | ress: er: | | McClo PO Bo CGS/1 | y Gro x 22: 1785 | oup Pi 14 Da | ty Ltd angar | NSW | 2309 |) | | | | | | | | | | | | Rep Rep | oort N | umbe ate: | r: | C(| GS/178 7/12/2 | 35 - 8 2014 | |
| Project: | | (| Geote | chnic | cal Inv | vestig | ation | 1 | | | | | | | | | | | | | Ord | ler Nu | mber | : | | | | |
| Location | | 5 | Stage | 2 Pit | tt Stre | et, T | eralba | 3 | | | | | | | | | | | | | _ | | | Page | e 1 of : | 1 | | |
| Lab No: | | | 14/11 | 1798 | | | | | | | | | | | | | | | | | San | nple L | ocatio. | on | - | - | | |
| Date Samp | plea: | | 28/11 | /201 | 14 | | | | | | | | | | | | | | | | | | ł | PIT NO | . 1P20 |)3 P | | |
| Sampled P | | | Dimce | 201 Stoi | ianov | eki | | | | | | | | | | | | | | | | c | ر عامسد | | b 0 4 | 0_0_80n | n | |
| Sample Me | ethod: | | AS128 | 39.1.3 | 2.1 c6 | 5.5.4 I | Backh | oe | | | | | | | | | | | | | Sumple Depth 0.40 0.0 | | | | | 0.001 | | |
| Material So | ource: | 1 | In situ | u | | | | | | | | | | | | | | | | | Test Method : AS1289 5 | | | | |).5.1.1 & A | \$1289.6.1.1 | |
| For Use As | 5: | | | | | | | | | | | | | | | | | | | | Lot | Numl | ber: | | - | | | |
| Remarks: | | | - | | | | | | | | | | | | | | | | | | Iter | n Nur | nber : | | - | | | |
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| 4,100 4,000 | | | | | | | | | | | | | | | | | | | | | | | | | | < | | |
| 3,900 3,800 3,700 | | | | | | | | | | | | | | | | | | | | | | | | / | | | | |
| 3,600 | | | | | | | | | | | | | | | | | 1 | | | | | | \leq | | | | | |
| 3,400 3,300 | <u> </u> | | | | | | | | | | | | | | | [| | | | - | _ | | | | | | | |
| 3,200 3,100 3,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2,900 2,800 | - | | | | - | | | | | | | | | 1 | | | | | | | | | | | | | | |
| 2,700 2,600 2,600 | | | | | - | - | | | | - | | \sim | | | | e | | | | | | | | | | | | |
| 2,500 2,400 2,300 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2,200 8, 2,100 | | | | | - | | | | | | | \vdash | | | | | | | | | | | | | | | | |
| 5 2,000 1,900 1,800 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1,700 | | | | | - | | | | | | | | | | | | | | | | | | | | | | | |
| 1,500 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1,200 | | | | | | | * | | | | | | | | | | | | | | | | | | | | | |
| 1,000 900 | - | | | | | * | | | | - | | | | | | | | | | | | | | | | | | |
| 800 700 600 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 500 400 | | | | ſ | - | | | | | | | | | | | | | | | | | | | | | | | |
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| Nomin | Com | pactiv Maxi | e Effori mum D | t : Dry De | nsity | _ | | | Sta | ndar | 1 | | | | Densi | ty Ra | tio afte | er Soa | k (%) | : | | | | 1 | 100 | | | |
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NATA Accred No:15689



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| Achieved [| ieved Dry Density before Soak (t/m ³) : 1.79 | | | | | | | | | | | | MOIST | ture C | ontent | (10ta) (%) | arte : | er Pen | etratio | n | | | | 15 | | | | |
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Approved Signatory Form Number Q___ RP29-3 Ian Piper

APPENDIX D:

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 boglike 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 |
| А | 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 |
| М | 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 |
| Р | Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise |

Tree root growth

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

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

Unevenness of Movement

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

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

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

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

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

Effects of Uneven Soil Movement on Structures

Erosion and saturation

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

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

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

Seasonal swelling/shrinkage in clay

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

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

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

Trees can cause shrinkage and damage

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

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

Movement caused by tree roots

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

Complications caused by the structure itself

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

Effects on full masonry structures

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

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

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

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

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

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred. The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

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

Effects on brick veneer structures

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

Water Service and Drainage

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

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

 Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

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

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

Prevention/Cure

Plumbing

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

Ground drainage

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

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

Protection of the building perimeter

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

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

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



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.

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