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Report on Lot Classification and Salinity Assessment

Proposed Residential Subdivision

Stage 2A, Birling - 975 The Northern Road, Bringelly NSW

Prepared for Cameron Brae Pty Ltd

Project 204684.17

13 January 2026

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Document History

Details

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Status	Prepared by	Reviewed by	Date issued
Revision 0	Thomas Bush	Konrad Schultz	13 January 2025

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

Signature		Date
Author		13 January 2025
Reviewer		13 January 2025

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Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Table of Contents

Report on Lot Classification and Salinity Assessment
Proposed Residential Subdivision
Stage 2A, Birling - 975 The Northern Road, Bringelly NSW

1. Introduction

This report presents the results of a lot classification and salinity assessment undertaken for a proposed residential subdivision at Stage 2A, Birling - 975 The Northern Road, Bringelly NSW. The investigation was commissioned by Cameron Brae Pty Ltd and was undertaken in accordance with Douglas Partners Pty Ltd (Douglas) proposal 204684.07.P.001.Rev0 dated 19 October 2023.

It is understood that the proposed development of the site includes the creation of 55 residential lots (Lots 2101 – 2155). Investigation was carried out to provide information on the subsurface conditions to allow for the classification of each lot in accordance with the requirements of AS 2870 *“Residential Slabs and Footings”* (AS 2870, 2011).

The investigation comprised the excavation of test pits and dynamic cone penetrometer (DCP) testing, followed by laboratory testing of selected samples, engineering analysis and reporting. Details of the field work and laboratory results are given in this report, together with comments relating to design and construction practice.

Site plans showing the subdivision layout prepared by YSCO Geomatics, the project surveyor, were provided by the client.

This report must be read in conjunction with all appendices including the notes provided in Appendix A.

2. Background

Previous investigation within the site was undertaken by Douglas with details given in a report titled “Report on Salinity Investigation and Management Plan, Stage 1 Birling Property, Proposed Residential Subdivision, 975 The Northern Road, Bringelly NSW” (Project 204684.01.R.001.Rev1) dated 6 June 2022 (Douglas, 2022).

In summary, results from the Douglas 2022 investigation indicate that the soils underlying the site are slightly to moderately saline, non-aggressive to mildly aggressive to steel and mildly to moderately aggressive to concrete.

3. Site description

The site is an irregular shaped area of approximately 2.6 ha (refer Drawing 1), with maximum north-south and east-west dimensions of some 210 m and 150 m respectively. The site is bounded by private residential properties to the north, and by neighbouring stages of the Birling residential development in all other directions.

Following the placement of topsoil, site levels fall to the southeast with an overall difference in level of approximately 8.5 m from the highest test location (RL 88.1 m relative to Australian Height Datum [AHD]) to the lowest (RL 79.6 m).

4. Geology

Reference to the NSW Seamless Geological Series (GSNSW, 2019) indicates that the site is underlain by Triassic aged Bringelly Shale of the Wianamatta Group. This formation typically comprises shale, carbonaceous claystone, claystone, laminite and fine to medium-grained lithic sandstone with occasional coal and tuff. Bringelly Shale typically weathers to form clays of medium to high plasticity. The results of the investigation were consistent with the geological mapping, with residual soil and/or shale or sandstone rock encountered in all test locations.

5. Field work

5.1 Methods

The field work comprised the excavation of 29 test pits (Pits 101 – 129) to depths in the range 0.4 – 2.0 m. The test pits were excavated using a Hyundai 60 CR-9 six tonne excavator fitted with a 450 mm wide, toothed bucket. The test pits were logged on site by a geotechnical engineer who collected disturbed and 'undisturbed' samples (in 50 mm diameter thin-walled steel tubes) to assist in strata identification and laboratory testing.

Dynamic cone penetrometer (DCP) tests were carried out to depths of up to 1.2 m adjacent to the test locations to assess the penetration resistance of the near-surface soils.

The test pit locations were nominated and located on site by Douglas and are shown on Drawing 1 (Appendix B). Surface levels relative to Australian Height Datum (AHD) and coordinates (to GDA 2020 MGA / Zone 56) were determined using a differential GPS which has a nominal accuracy of ±0.1 m. It is important to note that Douglas is not a registered surveyor, hence the coordinates and elevations will be considered approximate. Surface levels and coordinates are given on the test pit logs.

5.2 Results

The test pit logs are presented in Appendix C and must be read in conjunction with the accompanying standard notes defining classification methods and descriptive terms. The typical succession of strata is summarised as follows:

Topsoil:	Silty clay topsoil fill to depths of 0.1 – 0.3 m in Pits 101 – 129.
Clay:	Silty clay to depths of 0.5 – 1.5 m in Pits 101 – 103 and 116 – 118.
Rock:	Shale or sandstone from depths of 0.1 – 1.5 m in Pits 101 – 129, and continuing to limit of investigation depths in the range 0.4 – 2.0 m.

No free groundwater was observed in any of the test pits during the field work. It is noted that the pits were immediately backfilled following excavation, logging and sampling. Groundwater levels are affected by factors such as preceding climatic conditions and soil permeability and can therefore fluctuate time.

6. Laboratory testing

6.1 Plasticity and shrink swell index

Selected samples from the test pits were tested in the laboratory for measurement of field moisture content, plasticity and Shrink-swell index. The detailed laboratory test report sheets are presented in Appendix D, with the results summarised in Table 1.

Table 1: Summary of test results – Shrink-swell index and plasticity

Pit No.	Depth (m)	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)	Iss (%/ΔpF)	Material
101	0.5 – 0.77	18.6	-	-	-	-	2.6	Silty clay
113	0.5	12.0	47	20	27	13.0	-	Shale with clay
116	0.5 – 0.7	15.2	-	-	-	-	1.7	Silty clay
117	0.5	18.2	63	19	44	11.5	-	Silty clay
120	0.5	10.6	31	17	14	8.0	-	Sandstone with clay

Where:
FMC = Field moisture content
LL = Liquid limit
LS = Linear shrinkage
PL = Plastic limit
PI = Plasticity Index
Iss = Shrink-swell index

The field moisture contents of the soil samples were 0.8 – 8.0% dry of the plastic limit. The plasticity results indicate the soils tested are of low to high plasticity and would be susceptible to variable shrink-swell movements with changes in the soils moisture content. The Shrink-swell index (I_{ss}) results indicate that the soils are of medium shrink-swell potential.

6.2 Salinity, aggressivity, sodicity and dispersibility

Selected samples collected from the test locations were tested in the laboratory for determination of aggressivity to concrete and steel, sodicity (erosion potential), Emerson class number (dispersion potential), textural classification and salinity.

The detailed laboratory report sheets along with Summary Table D1 presenting the individual test results are presented in Appendix D. Table D1 also presents aggressivity and salinity classifications for each sample tested based on pH, chloride concentration, sulphate concentration, calculated resistivity and calculated ECe values.

The number of samples tested for each parameter and the range of test results obtained are summarised in Table 2.

Table 2: Results of laboratory testing – Chemical

Parameter		Units	Number of Tests	Range of Results
pH		pH units	42	4.5 – 9.2
Chlorides		mg/kg	10	28 – 730
Sulphates		mg/kg	10	36 – 460
Aggressivity (AS 2159:2009)	concrete	-	42	Non to moderately aggressive
	steel	-	42	Non to mildly aggressive
Na		meq/100g	4	1.7 – 3.4
CEC		meq/100g	4	5.3 – 21
Sodicity [Na/CEC]		ESP%	4	16.2 – 34.2
Sodicity Class [after DLWC]		-	4	Highly sodic
Emerson Class No.		-	1	2
EC1:5 [Lab.]		mS/cm	42	73 – 890
Resistivity		Ω.cm	42	1124 – 13699
ECe [M x EC1:5]		dS/m	42	0.4 – 6.2
Salinity Class [Richards 1954]		-	42	Non to moderately saline

Where: Na = Exchangeable Sodium CEC = cation exchange capacity M = soil textural factor

6.2.1 Aggressivity

Sample aggressivity classifications (refer Table D1, Appendix D) are based on pH, sulphate concentration, chloride concentration and calculated resistivity values and are assessed in accordance with AS 2159 *“Piling Design and Installation”* (AS 2159, 2009). The inferred very low permeability of the sampled clay-rich soils indicates that soils at all test pits are in Condition “B” (AS 2159, 2009).

The results indicate that:

- 27 samples were non-aggressive, 13 were mildly aggressive and two were moderately aggressive to concrete; and
- 28 samples were non-aggressive and 14 were mildly aggressive to steel.

6.2.2 Salinity

Sample salinity classifications (refer Table D1, Appendix D) are based on calculated ECe values using the method of Richards “*Diagnosis of Saline and Alkaline Soils.*” (Richards, 1954).

The results indicate that 15 samples were non-saline, 17 were slightly saline and ten were moderately saline.

6.2.3 Sodicity and dispersibility

The laboratory test results (refer Table D1, Appendix D) indicate that soils are highly sodic and would have potential for soil erosion if left exposed. Emerson class number testing undertaken on one sample at a depth of 0.5 m below ground level indicate shallow soils are Class 2, indicating a very high potential for dispersion.

7. Comments

7.1 Subsurface conditions

Based on the results of the investigation, the subsurface conditions typically comprise topsoil fill overlying residual clays and/or shale or sandstone. Free groundwater is not expected shallower than 2 – 3 m below ground level.

7.2 Fill placed on allotments

Regrading of the site comprised excavation to design levels, followed by placement of topsoil fill to depths of up to 0.3 m. Density testing was not required, as controlled fill was not placed within the lots. A works-as-executed (WAE) fill plan was not provided by the project surveyor.

7.3 Lot classification

Lot classification has been carried out by estimation of characteristic surface movements (y_s) using the methods outlined in AS 2870, taking account of the subsurface profiles determined from the test locations, laboratory measured plasticity and Shrink-swell index values and a crack depth of zero (for cut surfaces).

Characteristic surface movements (y_s) have been calculated of up to 50 mm. Accordingly, the lot classifications have been determined and are summarised in Table 3.

Table 3: Summary of Lot Classifications

Lot No.	Lot Classification
2104 – 2129 and 2134 – 2155	S
2101 – 2103	M
2130 – 2133	H1

Where:
S = Class S (slightly reactive)
M = Class M (moderately reactive)
H1 = Class H1 (highly reactive)

The classifications provided are appropriate for the undeveloped lots at the time of reporting. Revisions may be required once development details and proposed site works for individual lots are known. AS 2870 recommends that the classification of a site should be reconsidered if the depth of subsequent cutting exceeds 0.5 m or depth of subsequent fill exceeds 0.4 m.

7.4 Site preparation

Subject to site-specific design requirements, site preparation for the construction of residential structures will most likely include the removal of all vegetation, organic topsoils and other deleterious materials from the building area. Allowance will need to be made for variability in topsoil thicknesses, particularly as additional topsoil may have been spread after the excavation of the test pits.

Where a level building platform is to be constructed by cut and fill methods, reference should be made to Section 6.4.2 of AS 2870 which gives guidelines on fill placement methods and specification for compaction. The placement and compaction of fill should also be carried out in accordance with the requirements of Camden Council.

The requirements of Camden Council for controlled fill specify compaction of cohesive (clay) fill to a minimum dry density ratio of 95% relative to Standard compaction. Moisture content of the fill should be maintained near OMC measured in the Standard compaction test. Density testing would be required to confirm the placement of fill in the above controlled manner.

7.5 **Footings**

It is recommended that footing systems be designed and constructed in accordance with AS 2870 for the nominated classification (refer Section 7.4) and the additional requirements given in this report.

Footing systems founded uniformly in natural stiff or stronger clay or future controlled fill could be designed using an allowable bearing pressure of 100 kPa. Footings founded in very low strength (or greater) rock could be designed using an allowable bearing pressure of 700 kPa.

Where footing systems are proposed adjacent to services or retaining walls or located through areas of uncontrolled fill (for example, following construction of a level building platform placed without engineering control), local deepening of the footings or alternatively the inclusion of piers will most likely be required. Founding levels should also be constructed below the zone of influence of the service trenches and retaining walls, which is generally taken to be within a 45° (ie: 1 horizontal:1 vertical) line extending from the base of the trench or retaining wall to the ground surface and through fill to the residual (undisturbed) soils or weathered rock.

Where partial rock foundations result following construction of cut to fill platforms or where exposed conditions include controlled fill, residual soils/rock and/or large variations in controlled fill depth, reference must be made to AS 2870:2011 regarding the provision of articulation within the structure and/or the construction of a foundation system that provides uniform bearing.

All footing systems should be designed and constructed in accordance with sound engineering principles, with care exercised to ensure that footing trenches/piers are inspected for design compliance prior to the placement of steel and pouring of concrete.

Where raft slabs are proposed, the raft stiffness should be designed in accordance with the designated lot classification and the requirements of AS 2870:2011. If a suspended raft is proposed, then it must take account of the likely range of swell movements of the construction platform for the relevant classification.

Masonry walls should be articulated in accordance with Cement Concrete & Aggregates Australia *"Technical Note 61, Articulated Walling"* (CCAA, 2008).

7.6 Site maintenance and drainage

The site classifications in Section 7.4 are conditional on the developed lots being maintained in accordance with the CSIRO publication *Foundation Maintenance and Footing Performance*, a copy of which is included in Appendix E.

Whilst it must be accepted that some minor cracking in most structures is inevitable on reactive sites, the guide describes suggested site maintenance practices aimed at limiting foundation movements and at keeping cracking within acceptable limits.

Surface drainage should be installed and maintained at the site. If drainage measures (surface and subsurface) are not installed and maintained adverse moisture conditions could arise, and footing performance could be compromised. All collected stormwater, groundwater and roof runoff should be discharged into the stormwater disposal system.

8. Salinity management plan

As there is potential for salts to be mobile, a “worst-case” scenario was adopted to determine the salinity and aggressivity classifications for each lot. This was achieved by comparing the worst-case salinity and aggressivity to concrete and steel classifications from each test location (refer Table D1, Appendix D) from this investigation with the results of Douglas’ previous investigation (Douglas, 2022). The adopted aggressivity to concrete and steel and salinity classifications for each lot are summarised in Table 4.

Table 4: Aggressivity and salinity classification summary

Lot No.	Exposure classification for concrete (AS 3600)	Exposure classification for concrete piles (AS 2159)	Exposure classification for steel piles (AS 2159)	Salinity classification (Richards 1954)
2151 – 2155	A2	Mild	Mild	Slightly saline
2108 – 2124 and 2138 – 2150	A2	Mild	Mild	Moderately saline
2101 – 2107 and 2125 – 2137	B1	Moderate	Mild	Moderately saline

The classifications given in Table 4 must be taken into account by the designer when determining durability and corrosion requirements as per AS 3600:2018 *“Concrete Structures”* (AS 3600, 2018), AS 2159:2009 *“Piling Design and Installation“* (AS 2159, 2009) and *“Precast concrete pipes”* (AS 4058, 2007) for:

- Concrete foundations and concrete structure (AS 3600).
- Concrete piles (AS 2159).
- Corrosion allowances for steel (as per AS 2159).
- Precast concrete pipes (as per AS 4058).

The above should be complementary to standard building practices.

This Salinity Management Plan (SMP) is a post earthworks assessment only and as such, the classifications given within do not apply to services previously installed during the bulk earthworks and civil works phases of the development.

This SMP supersedes the SMP provided for residential development purposes within the site given in the previous Douglas 2022 report.

9. References

AS 2159. (2009). *Piling Design and Installation*. Standards Australia.

AS 2870. (2011). *Residential Slabs and Footings*. Standards Australia.

AS 3600. (2018). *Concrete Structures*. including Amendment 1:2018 and Amendment 2:2021: Standard Australia.

AS 4058. (2007). *Precast Concrete Pipe (Pressure and Non-Pressure)*. Australian Standard.

CCAA. (2008). *TN61, Articulated Walling*. Technical Note 61, 3rd Edition: Cement Concrete & Aggregates Australia.

Douglas. (2022). *Report on Salinity Investigation and Management Plan, Stage 1 Birling Property, Proposed Residential Subdivision, 975 The Northern Road, Bringelly NSW*. Macarthur: Douglas Partners Pty Ltd, Project 204684.01.R.001.Rev0.

GSNSW. (2019). *NSW Seamless Geology*. Geological Survey NSW Web Map Service.

Richards, L. A. (1954). *Diagnosis of Saline and Alkaline Soils*. Washington D.C: US Department of Agriculture.

10. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report (or services) for this project at Stage 2A, Birling - 975 The Northern Road, Bringelly NSW in line with Douglas' proposal dated 19 October 2023 and acceptance received from Cameron Brae Pty Ltd. The work was carried out under Douglas' Engagement Terms. This report is provided for the use of Cameron Brae Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

Appendix A

About this report

About this Report

October 2024

Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Engagement Terms for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, Douglas cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, Douglas requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. Douglas would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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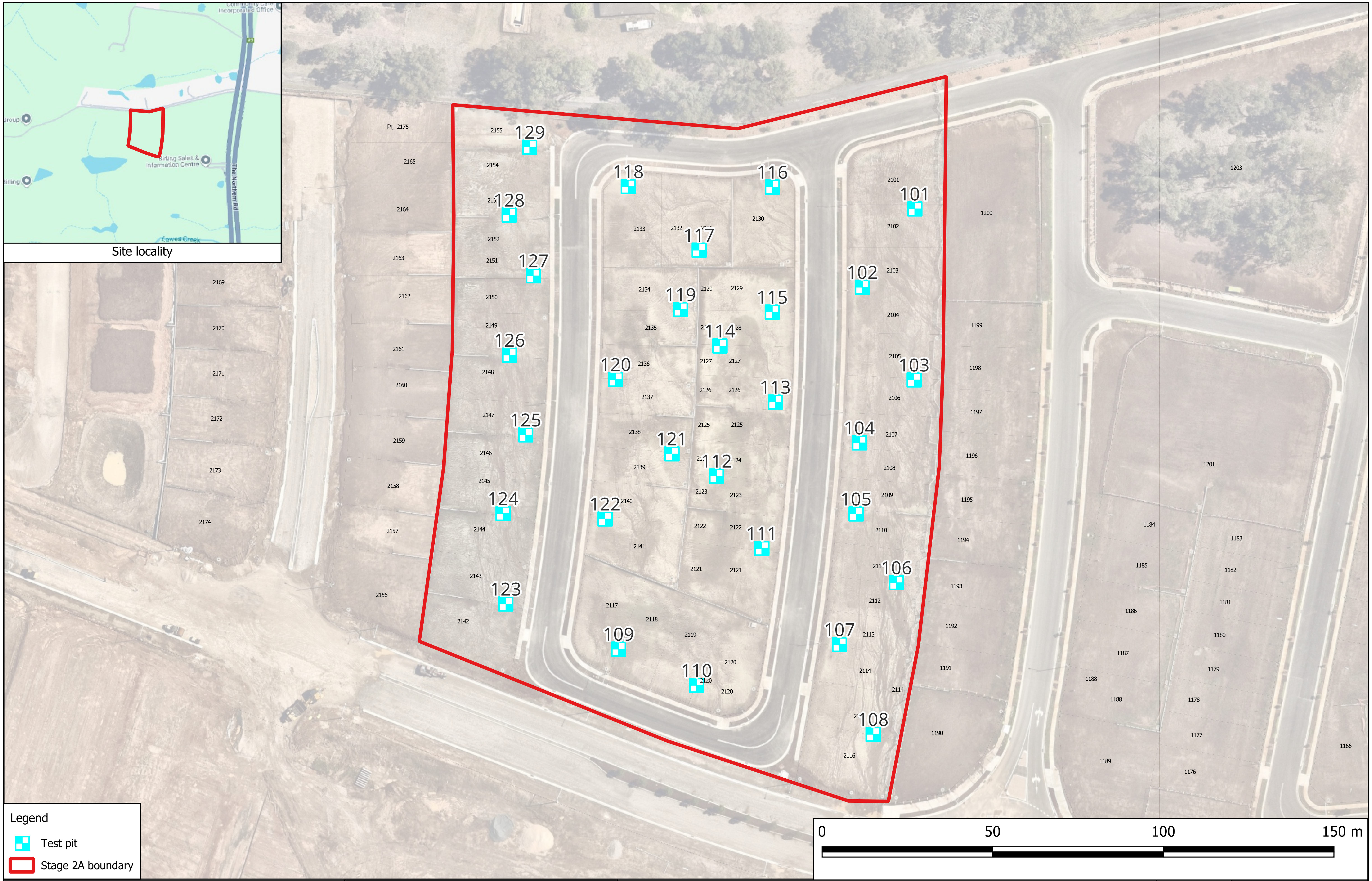
Appendix B

Drawing 1 – Test location plan

Site plan (prepared by YSCO Geomatics)



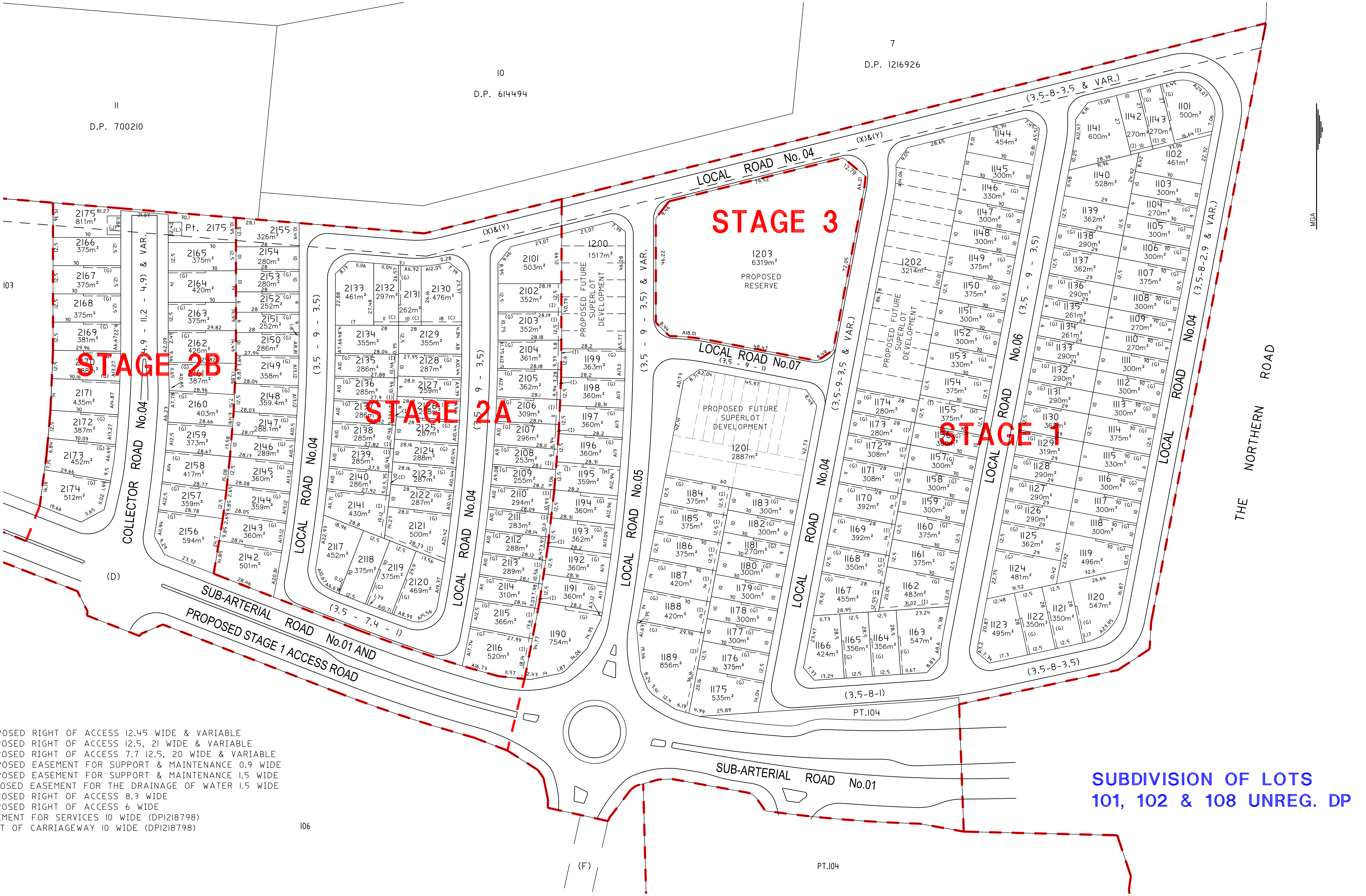
Douglas Partners

GROUNDED EXPERTISE

CLIENT: Cameron Brae Pty Ltd	
OFFICE: Macarthur	DRAWN BY: TB
SCALE: As shown	DATE: 5 January 2026

TITLE: **Test location plan**
Proposed residential subdivision
Stage 2A, Birling - 975 The Nothern Road, Bringelly NSW

PROJ. #:	204684.17
DRAWING No:	1
REVISION:	0



SUBDIVISION OF LOTS 101, 102 & 108 UNREG. DP

(D) PROPOSED RIGHT OF ACCESS 12.45 WIDE & VARIABLE
(E) PROPOSED RIGHT OF ACCESS 12.5, 21 WIDE & VARIABLE
(F) PROPOSED RIGHT OF ACCESS 7.7 12.5, 20 WIDE & VARIABLE
(G) PROPOSED EASEMENT FOR SUPPORT & MAINTENANCE 0.9 WIDE
(H) PROPOSED EASEMENT FOR SUPPORT & MAINTENANCE 1.5 WIDE
(I) PROPOSED EASEMENT FOR THE DRAINAGE OF WATER 1.5 WIDE
(J) PROPOSED RIGHT OF ACCESS 8.3 WIDE
(L) PROPOSED RIGHT OF ACCESS 6 WIDE
(X) EASEMENT FOR SERVICES 10 WIDE (DP1218798)
(Y) RIGHT OF CARRIAGEWAY 10 WIDE (DP1218798)

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NOTES:

ALL DIMENSIONS AND AREAS ARE SUBJECT TO FINAL SURVEY AND REGISTRATION OF PLANS OF SUBDIVISION AT N.S.W. LAND REGISTRY SERVICES.

DATE	REVISIONS	BY
17/3/25	SUB-ARTERIAL ROAD STAGE BDY AMENDED	P.Y.
14/3/25	STAGING BDY AMENDED	V.K.
19/02/25	SHEET 1 AMENDED	P.Y
18/02/25	MINOR BOUNDARY DISCREPANCIES LOTS 2142-2174 AMENDED,	P.Y.
21/01/25	AREAS LOTS 2142,2151,2152,2163 AMENDED, E'MENT FOR SUPPORT LOT 2130 REMOVED	P.Y.
30/10/24	LOT 104 AMENDED	VK
16/10/24	EASEMENTS ADDED	VK

DATE	REVISIONS	BY
11/06/24	INCONSISTANCIES IN STAGE 2 BOUNDARIES AMENDED	PY
03/06/24	NOTE RELATING TO OPEN SPACE LOT 1203	PY
06/03/24	AMEND LOT 104 BOUNDARIES	PY
10/01/24	AMEND BOUNDARIES LOTS 2101/2102 & LOTS 1144/1145	PY
09/01/24	AMEND BOUNDARIES LOTS 1120 & 2131/2130	PY
20/12/23	ROAD No.4 WIDENED ALONG N. BOUNDARY LOT 2175 RECONFIGURED; LOTS 2166-2175 RENUMBERED	PY
29/8/23	ACCESS ROAD LOT 106 REMOVED	PY

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PLAN OF PROPOSED DEVELOPMENT AT LOWES CREEK,
No. 975 THE NORTHERN ROAD, BRINGELLY, BEING
LOT 120 IN D.P. 1284706 IN CAMDEN L.G.A.

DRAWN:	CHECKED:	SCALE:	DATUM:	REFERENCE:
08 AUGUST 2023	P.Y.	1:800 @ A1		5421/4P SHT 2 OF 2 SHTS

Appendix C

Test pit logs (Pits 101 – 129)

Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when augering in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	**Particle Size (mm)**	**Behaviour Model**	
		Behaviour	**Approximate Dry Mass**
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	**Definition[1]**	**Relative Proportion**	
		In Fine Grained Soil	**In Coarse Grained Soil**
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	“oozes” when agitated	w=LL
	Wet of liquid limit	“oozes”	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning “not-assessable due to drilling fluid use” may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the “consistency” describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented “strength” is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Soil Descriptions

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as “extremely weathered material” in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than ‘very low’ as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be “oversize” may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with “MIXTURE OF”.

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Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $I_{s(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Unconfined Compressive Strength (MPa)	Point Load Index[1] $I_{s(50)}$ MPa	Abbreviation Code
Very low	0.6 - 2	0.03 - 0.1	VL
Low	2 - 6	0.1 - 0.3	L
Medium	6 - 20	0.3 - 1.0	M
High	20 - 60	1 - 3	H
Very high	60 - 200	3 - 10	VH
Extremely high	>200	>10	EH

[1] Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load Index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material "within rock" but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns.	SOIL
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	SEAM

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil[1]	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.	RS
Extremely weathered[1]	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible	XW
Highly weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.	HW
Moderately weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MW
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	SW
Fresh	No signs of decomposition or staining.	FR
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	DW

[1] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Rock Descriptions

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} > 100\text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e., drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Rock Descriptions

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Cleavage	CL
Crushed seam	CS
Crushed zone	CZ
Drilling break	DB
Decomposed seam	DS
Drill lift	DL
Extremely Weathered seam	EW
Fault	F
Fracture	FC
Fragmented	FG
Handling break	HB
Infilled seam	IS
Joint	JT
Lamination	LAM
Shear seam	SS
Shear zone	SZ
Vein	VN
Mechanical break	MB
Parting	P
Sheared Surface	S

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CN
Coating	CT
Healed	HE
Infilled	INF
Stained	SN
Tight	TI
Veneer	VNR

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLAY
Iron oxide	FE
Manganese	MN
Pyrite	Py
Secondary material	MS
Silt	M
Quartz	Qz
Unidentified material	MU

Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Discontinuous	DIS
Irregular	IR
Planar	PR
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RF
Smooth	SM
Slickensided	SL
Very rough	VR

Defect Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

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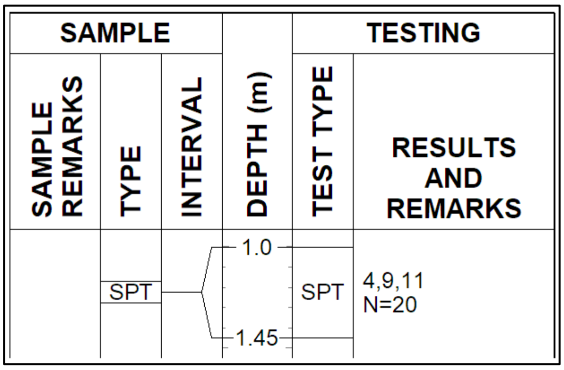
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

March 2025

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150
Dynamic probe super heavy, followed by blow count penetration increment in mm	DPSH/100

Groundwater Observations

▷—	water seepage/inflow
◁—	water seepage/outflow
▼	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 84.3 AHD
COORDINATE: E:290728.9, N:6240327.8
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 101
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED

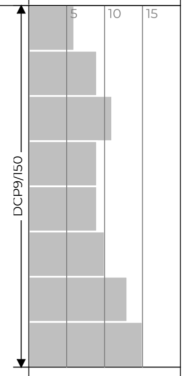
GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH
24/11/25 No free groundwater observed		FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.	FILL	NA	w<PL			
	0.30	Silty CLAY (CI-CH): red-brown mottled pale grey; medium to high plasticity; trace rootlets.	RS	VSt	w<PL			
		From 1.00m: grading to pale grey mottled orange-brown with very low strength sandstone bands		H				
	1.50	SANDSTONE: orange-brown; with extremely weathered bands. Bringelly Shale.				HW	1.50	L

Test Pit discontinued at 1.60m depth.
Refusal on low strength sandstone.

SAMPLE

SAMPLE REMARKS	TYPE	INTERVAL / DEPTH (m)
	D	0.50
	U50	0.50 – 0.77
	D	1.00
	D	1.50

TESTING



NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

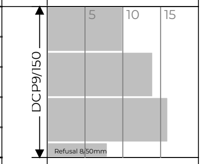
TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 84.1 AHD
COORDINATE: E:290713.5, N:6240305.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 102
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	84	0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.50	Silty CLAY (CI-CH): pale grey mottled orange-brown; medium to high plasticity; with very low strength sandstone bands.		RS	H	w<PL					D		0.50		
			SANDSTONE: orange-brown and pale grey. Bringelly Shale.					HW	0.50	L						



Test Pit discontinued at 0.60m depth.
Refusal on low strength sandstone.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

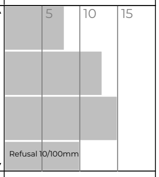
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 83.0 AHD
COORDINATE: E:290728.7, N:6240278.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 103
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▒	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	83	0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.60	Silty CLAY (CI-CH): pale grey mottled orange-brown; medium to high plasticity; with very low strength shale bands.		RS	H	w<PL					D		0.50		
			SHALE: grey. Bringelly Shale.					HW	0.60	L - M						
	82	1														
	81	2														
	80	3														
	79	4														

Test Pit discontinued at 0.70m depth.
Refusal on low to medium strength shale.

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 82.8 AHD
COORDINATE: E:290712.6, N:6240259.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 104
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▩	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS 5 10 15
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	Refusal 12/80mm
			SHALE: grey; with extremely weathered bands. Bringelly Shale.					HW	0.20 0.40	VL - L L - M		D		0.50		
			Test Pit discontinued at 0.50m depth. Refusal on low to medium strength shale.													
	82															
		1														
	81															
		2														
	80															
		3														
	79															
		4														
	78															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Douglas
PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 81.8 AHD
COORDINATE: E:290711.6, N:6240238.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 105
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	5 10 15 Refusal 10/50mm
			SHALE: grey; with extremely weathered bands. Bringelly Shale.					HW	0.20 0.40	VL - L L - M		D		0.50		

Test Pit discontinued at 0.50m depth.
Refusal on low to medium strength shale.

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

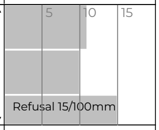
Douglas
PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 81.0 AHD
COORDINATE: E:290723.5, N:6240218.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 106
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											**SAMPLE**				**TESTING**	
					SOIL			**ROCK**								
GROUNDWATER	**RL (m)**	**DEPTH (m)**	**DESCRIPTION OF STRATA**	**GRAPHIC**	**ORIGIN(#)**	**CONSIS.(*) DENSITY.(*)**	**MOISTURE**	**WEATH.**	**DEPTH (m)**	**STRENGTH** VL L M H VH EH	**SAMPLE REMARKS**	**TYPE**	**INTERVAL**	**DEPTH (m)**	**TEST TYPE**	**RESULTS AND REMARKS**
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 15/100mm
		0.30	SHALE: grey and pale brown. Bringelly Shale.					HW	0.30	VL - L						
									0.50	L - M		D		0.50		
	80	1														
	79	2														
	78	3														
	77	4														

Test Pit discontinued at 0.70m depth.
Refusal on low to medium strength shale.

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

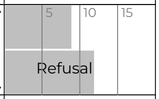
Douglas
PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 80.5 AHD
COORDINATE: E:290706.8, N:6240200.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 107
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed		0.30	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal
	80		SHALE: grey and pale brown. Bringelly Shale.					HW	0.30 0.50	VL - L L - M		D		0.50		
			Test Pit discontinued at 0.60m depth. Refusal on low to medium strength shale.													
		1														
	79															
		2														
	78															
		3														
	77															
		4														
	76															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 79.6 AHD
COORDINATE: E:290716.7, N:6240174.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 108
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED				SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m) DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed		FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	Refusal
	0.30	SHALE: grey. Bringelly Shale.					HW	0.30	L-M		D		0.40		
		Test Pit discontinued at 0.40m depth. Refusal on low to medium strength shale.													

RL (m): 79, 78, 77, 76, 75
DEPTH (m): 1, 2, 3, 4

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

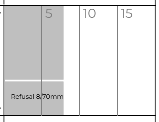
Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 80.7 AHD
COORDINATE: E:290642.0, N:6240199.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 109
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.20	SHALE: grey. Bringelly Shale.					HW	0.20	L - M		D		0.40		
	80															
		1														
	79															
		2														
	78															

Test Pit discontinued at 0.40m depth.
Refusal on low to medium strength shale.

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 80.4 AHD
COORDINATE: E:290664.9, N:6240188.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 110
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS 5 10 15
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	Refusal 10/50mm
			SHALE: grey. Bringelly Shale.					HW	0.20	L - M		D		0.40		
	80		Test Pit discontinued at 0.40m depth. Refusal on low to medium strength shale.													
		1														
	79															
		2														
	78															
		3														
	77															
		4														
	76															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

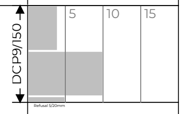
Douglas PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 81.4 AHD
COORDINATE: E:290684.0, N:6240228.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 111
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 5/20mm
		0.30	SHALE: grey. Bringelly Shale.					HW	0.30	L - M		D		0.40		
	81															
		1														
	80															
		2														
	79															
		3														
	78															
		4														
	77															

Test Pit discontinued at 0.40m depth.
Refusal on low to medium strength shale.

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

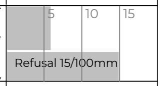
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 82.5 AHD
COORDINATE: E:290670.7, N:6240250.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 112
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 15/100mm
		0.20	SHALE: grey; with extremely weathered bands. Bringelly Shale.					HW	0.20 0.40	VL - L L - M		D		0.50		
	82		Test Pit discontinued at 0.50m depth. Refusal on low to medium strength shale.													
		1														
	81															
		2														
	80															
		3														
	79															
		4														
	78															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

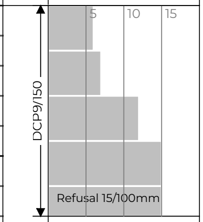
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 83.3 AHD
COORDINATE: E:290688.0, N:6240271.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 113
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 15/100mm
	83	0.30	SHALE: pale brown and grey; with clay bands. Bringelly Shale.					XW - HW	0.30	VL		D		0.50		
								HW	0.70	L - M		D		0.90		
		1	Test Pit discontinued at 0.90m depth. Refusal on low to medium strength shale.													
	82															
		2														
	81															
		3														
	80															
		4														
	79															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

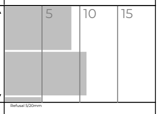
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 84.0 AHD
COORDINATE: E:290671.7, N:6240288.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 114
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.30	SANDSTONE: pale grey and orange-brown; with extremely weathered bands. Bringelly Shale.					HW	0.30	L - M		D		0.50		
			Test Pit discontinued at 0.50m depth. Refusal on low to medium strength sandstone.													
	83	1														
	82	2														
	81	3														
	80	4														
	79															

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

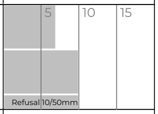
Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 84.0 AHD
COORDINATE: E:290687.1, N:6240298.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 115
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 10/50mm
		0.30	SANDSTONE: pale brown and grey. Bringelly Shale.					HW	0.30	L - M		D		0.40		
			Test Pit discontinued at 0.40m depth. Refusal on low to medium strength sandstone.													
	83	1														
	82	2														
	81	3														
	80	4														

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

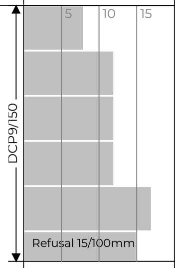
CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 85.4 AHD
COORDINATE: E:290687.1, N:6240334.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 116
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] ▨ DENSITY.[*] ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL									
	85	1.20	Silty CLAY (CI-CH): pale grey mottled red-brown; medium to high plasticity; trace rootlets. From 0.70m: grading to pale grey mottled orange-brown with very low strength sandstone bands		RS	H	w<PL					D U50 D		0.50 0.70 1.00	DCP9/150	Refusal 15/100mm
	84		SANDSTONE: orange-brown; with extremely weathered bands. Bringelly Shale.					HW	1.20	L		D		1.30		

Test Pit discontinued at 1.30m depth.
Refusal on low strength sandstone.



NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

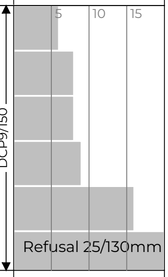
CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 86.3 AHD
COORDINATE: E:290665.6, N:6240316.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 117
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	SOIL ORIGIN(#)	SOIL CONSIS.(*) DENSITY.(*)	SOIL MOISTURE	ROCK WEATH.	ROCK DEPTH (m)	ROCK STRENGTH (VL L M H VH EH)	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	86	0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.	FILL	NA	w<PL								DCP9/150	
			Silty CLAY (CH): pale grey mottled red-brown; high plasticity; trace rootlets.		VSt						D		0.50		
		1	From 0.60m: with very low strength shale bands	RS	H	w<PL					D		1.00		Refusal 25/130mm
	85	1.40	SHALE: orange-brown and grey. Bringelly Shale.				HW	1.40	L - M		D		1.50		



Test Pit discontinued at 1.60m depth.
Refusal on low to medium strength shale.

RL (m)	DEPTH (m)
84	2
83	3
82	4

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

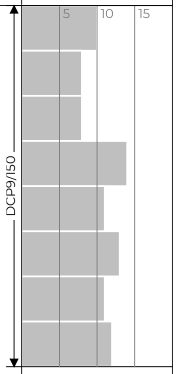
TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 87.3 AHD
COORDINATE: E:290644.9, N:6240334.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 118
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH (VL L M H VH EH)	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	87	0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
			Silty CLAY (CI-CH): pale grey mottled red-brown; medium to high plasticity; trace rootlets.		RS	VSt	w<PL					D		0.50		
	86	1.50	From 0.50m: with very low strength shale bands			VSt - H						D D		1.00 1.50		
		2	SHALE: pale grey and red-brown; with extremely weathered bands. Bringelly Shale.					HW	1.50 1.90	VL - L L - M		D		2.00		



Test Pit discontinued at 2.00m depth.
Refusal on low to medium strength shale.

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

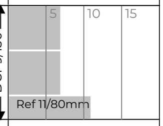
Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 85.9 AHD
COORDINATE: E:290660.2, N:6240298.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 119
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Ref 11/80mm
		0.30	SHALE: pale grey and orange-brown; with extremely weathered bands and clay bands.					HW	0.30	VL - L		D		0.50		
			From 0.80m: grading to grey						0.80	L - M		D		1.00		
	85	1														

Test Pit discontinued at 1.00m depth.
Refusal on low to medium strength shale.

RL (m)	DEPTH (m)
84	2
83	3
82	4
81	

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

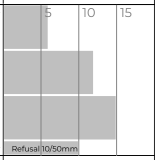
Douglas PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 85.0 AHD
COORDINATE: E:290641.1, N:6240278.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 120
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	85		FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.30	SANDSTONE: pale brown and pale grey. Bringelly Shale.					HW	0.30	L		D		0.50		
												D		0.60		
			Test Pit discontinued at 0.60m depth. Refusal on low strength sandstone.													
	84	1														
	83	2														
	82	3														
	81	4														

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

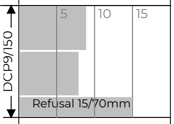
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 83.9 AHD
COORDINATE: E:290657.7, N:6240256.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 121
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH (VL L M H VH EH)	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.30	SHALE: grey; with extremely weathered shale bands. Bringelly Shale.					HW	0.30 0.50	VL - L L - M		D		0.50		
			Test Pit discontinued at 0.60m depth. Refusal on low to medium strength shale.													
	83	1														
	82	2														
	81	3														
	80	4														
	79															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

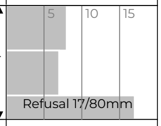
Douglas PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 83.0 AHD
COORDINATE: E:290638.1, N:6240237.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 122
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	83		FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.	☒	FILL	NA	w<PL								DCP9/150	 Refusal 17/80mm
		0.30	SHALE: grey; with clay bands. Bringelly Shale.	▒				HW	0.30	VL - L		D		0.50		
									0.80	L - M		P				
	82	1												1.00		

Test Pit discontinued at 1.00m depth.
Refusal on low to medium strength shale.

RL (m)	DEPTH (m)
81	2
80	3
79	4

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

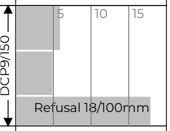
Refer to explanatory notes for symbol and abbreviation definitions

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 81.7 AHD
COORDINATE: E:290609.0, N:6240212.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 123
PROJECT No: 204684.17
DATE: 24/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	 5 10 15 Refusal 18/100mm
		0.30	SHALE: grey and red-brown; with extremely weathered bands, with clay bands. Bringelly Shale.					HW	0.30 0.50	VL - L L - M		D		0.50		
	81 80 79 78 77	1 2 3 4	Test Pit discontinued at 0.60m depth. Refusal on low to medium strength shale.													

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

Refer to explanatory notes for symbol and abbreviation definitions

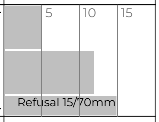
Douglas PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 83.1 AHD
COORDINATE: E:290608.2, N:6240239.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 124
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	83	0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL		0.20						DCP9/150	 Refusal 15/70mm
			SHALE: grey; with extremely weathered bands, with clay bands. Bringelly Shale.					HW	0.60	VL - L L - M		D		0.50		
			Test Pit discontinued at 0.70m depth. Refusal on low to medium strength shale.													

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

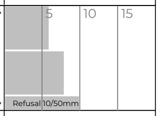
Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 84.4 AHD
COORDINATE: E:290614.8, N:6240262.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 125
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] ▇ DENSITY.[*] ▒	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
	84	0.30	SHALE: pale brown and grey. Bringelly Shale.					HW	0.30	L - M		D		0.50		
			Test Pit discontinued at 0.50m depth. Refusal on low to medium strength shale.													
	83	1														
	82	2														
	81	3														
	80	4														

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 85.7 AHD
COORDINATE: E:290610.1, N:6240285.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 126
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL		0.20						DCP9/150	5 10 15 Refusal 23/80mm
			SHALE: grey and pale brown. Bringelly Shale.					HW		L - M						

Test Pit discontinued at 0.50m depth.
Refusal on low to medium strength shale.

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

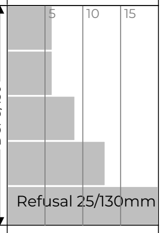
Douglas PARTNERS

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 86.8 AHD
COORDINATE: E:290617.0, N:6240308.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 127
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▮ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
No free groundwater observed 24/11/25			FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	
		0.30	SHALE: grey and red-brown; with extremely weathered bands and with clay bands. Bringelly Shale.					HW	0.30	VL - L		D		0.50		
									0.70	L - M						
	86		Test Pit discontinued at 0.80m depth. Refusal on low to medium strength shale.													
		1														
	85															
		2														
	84															
		3														
	83															
		4														
	82															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 87.8 AHD
COORDINATE: E:290610.0, N:6240326.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 128
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED											SAMPLE				TESTING	
					SOIL			ROCK								
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS 5 10 15
24/11/25 No free groundwater observed		0.20	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.		FILL	NA	w<PL								DCP9/150	Refusal 25/130mm
			SHALE: grey; with extremely weathered bands. Bringelly Shale.					HW	0.20 0.40	VL - L L - M		D		0.50		
			Test Pit discontinued at 0.50m depth. Refusal on low to medium strength shale.													
	87	1														
	86	2														
	85	3														
	84	4														
	83															

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations
LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

TEST PIT LOG

CLIENT: Cameron Brae Pty Ltd
PROJECT: Proposed Residential Subdivision
LOCATION: Stage 2A, Birling – 975 The Northern Road, Bringelly

SURFACE LEVEL: 88.1 AHD
COORDINATE: E:290616.0, N:6240346.0
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: 129
PROJECT No: 204684.17
DATE: 25/11/25
SHEET: 1 of 1

CONDITIONS ENCOUNTERED					SOIL			ROCK			SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▒ DENSITY.(*) ▨	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
24/11/25 No free groundwater observed	88	0.10	FILL / TOPSOIL / Silty CLAY (CL-CI): brown; low to medium plasticity; trace fine to coarse gravel and rootlets.	×	FILL	NA	w<PL								DCP9/150	Refusal 7/100mm 5 10 15
			SANDSTONE: pale brown. Bringelly Shale.	▦				HW	0.10	L - M		D		0.40		
			Test Pit discontinued at 0.40m depth. Refusal on low to medium strength sandstone.													
	87	1														
	86	2														
	85	3														
	84	4														

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hyundai 60CR-9 excavator
METHOD: 450mm toothed bucket
REMARKS:

OPERATOR: Quake Excavations

LOGGED: TKB

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE-GS by Geroc - Soil with Simple Rock Log

Appendix D

Laboratory results

Summary Table D1

Material Test Report

Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **204684.17-3**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Changed material descriptions as requested by engineer.*
Date Issued: 06/01/2026
Client: Cameron Brae Pty Ltd
975 The Northern Road, Bringelly NSW
Contact: James Dunbar
Project Number: 204684.17
Project Name: Proposed Residential Subdivision
Project Location: 975 The Northern Road, Bringelly NSW
Work Request: 17572
Sample Number: MA-17572E
Client Sample #: 113
Date Sampled: 25/12/2025
Dates Tested: 02/12/2025 - 18/12/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **113 , Depth: 0.5 m**
Material: SHALE with clay bands

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	47		
Plastic Limit (%)	20		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.0**		
Cracking Crumbling Curling	Cracking & Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	12.0		

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Results relate only to the items tested/sampled.

Material Test Report

Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **204684.17-3**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Changed material descriptions as requested by engineer.*
Date Issued: 06/01/2026
Client: Cameron Brae Pty Ltd
975 The Northern Road, Bringelly NSW
Contact: James Dunbar
Project Number: 204684.17
Project Name: Proposed Residential Subdivision
Project Location: 975 The Northern Road, Bringelly NSW
Work Request: 17572
Sample Number: MA-17572F
Client Sample #: 117
Date Sampled: 25/12/2025
Dates Tested: 02/12/2025 - 18/12/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **117 , Depth: 0.5 m**
Material: Silty CLAY

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	63		
Plastic Limit (%)	19		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.5**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	18.2		

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Material Test Report

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Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **204684.17-3**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Changed material descriptions as requested by engineer.*
Date Issued: 06/01/2026
Client: Cameron Brae Pty Ltd
975 The Northern Road, Bringelly NSW
Contact: James Dunbar
Project Number: 204684.17
Project Name: Proposed Residential Subdivision
Project Location: 975 The Northern Road, Bringelly NSW
Work Request: 17572
Sample Number: MA-17572G
Client Sample #: 120
Date Sampled: 25/12/2025
Dates Tested: 02/12/2025 - 18/12/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **120 , Depth: 0.5 m**
Material: SANDSTONE with clay bands

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	31		
Plastic Limit (%)	17		
Plasticity Index (%)	**14**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**8.0**		
Cracking Crumbling Curling	Cracking		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	10.6		

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Material Test Report

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Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Report Number: **204684.17-3**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Changed material descriptions as requested by engineer.*
Date Issued: 06/01/2026
Client: Cameron Brae Pty Ltd
975 The Northern Road, Bringelly NSW
Contact: James Dunbar
Project Number: 204684.17
Project Name: Proposed Residential Subdivision
Project Location: 975 The Northern Road, Bringelly NSW
Work Request: 17572
Sample Number: MA-17572I
Client Sample #: 101
Date Sampled: 25/12/2025
Dates Tested: 19/12/2025 - 19/12/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **101 (0.5 - 0.77 m)**
Material: Silty CLAY

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled water		

Material Test Report

Report Number: **204684.17-3**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Changed material descriptions as requested by engineer.*
Date Issued: 06/01/2026
Client: Cameron Brae Pty Ltd
975 The Northern Road, Bringelly NSW
Contact: James Dunbar
Project Number: 204684.17
Project Name: Proposed Residential Subdivision
Project Location: 975 The Northern Road, Bringelly NSW
Work Request: 17572
Date Sampled: 25/11/2025
Dates Tested: 01/12/2025 - 10/12/2025
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Location: 975 The Northern Road, Bringelly

Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
Senior Technician
Laboratory Accreditation Number: 828

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	MA-17572A	MA-17572B	MA-17572C	MA-17572D	
Date Sampled	25/12/2025	25/12/2025	25/12/2025	25/12/2025	
Date Tested	04/12/2025	04/12/2025	10/12/2025	08/12/2025	
Material Source	**	**	**	**	
Sample Location	101 (0.5 - 0.77 m)	116 (0.5 - 0.7 m)	130 (0.5 - 0.8 m)	134 (0.3 - 0.49 m)	
Inert Material Estimate (%)	0	7	0	2	
Pocket Penetrometer before (kPa)	320	540	290	410	
Pocket Penetrometer after (kPa)	210	300	170	260	
Shrinkage Moisture Content (%)	19.1	14.3	14.8	**	
Shrinkage (%)	**4.3**	**0.8**	**1.6**	**	
Swell Moisture Content Before (%)	18.6	15.2	17.9	13.1	
Swell Moisture Content After (%)	21.1	22.4	23.3	16.5	
Swell (%)	**0.8**	**4.7**	**1.6**	**0.9**	
Shrink Swell Index Iss (%)	**2.6**	**1.7**	**1.3**	**	
Visual Description	Silty CLAY	Silty CLAY	Silty CLAY	Silty CLAY	
Cracking	MC	HC	MC	**	
Crumbling	Yes	No	No	Yes	
Remarks	**	**	**	**	

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.

Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.

Scope of accreditation does not cover the performance of pocket penetrometer readings.

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Results relate only to the items tested/sampled.

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 396940

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Nathan Godina
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**204684.17 Bringelly**
Number of Samples	60 Soil
Date samples received	28/11/2025
Date completed instructions received	02/12/2025

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client unless as indicated below in the method summaries. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	05/12/2025
Date of Issue	10/12/2025
Reissue Details	This report replaces R00 due to amendments to sample ID.

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Giovanni Agosti, Group Technical Manager
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

ESP/CEC						
Our Reference		396940-1	396940-3	396940-5	396940-10	396940-13
Your Reference	UNITS	101	109	116	127	135
Depth		0.5	0.4	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/12/2025	05/12/2025	05/12/2025	05/12/2025	05/12/2025
Date analysed	-	05/12/2025	05/12/2025	05/12/2025	05/12/2025	05/12/2025
Exchangeable Ca	meq/100g	0.3	5.1	<0.1	2.3	0.3
Exchangeable K	meq/100g	<0.1	0.6	0.2	0.4	0.4
Exchangeable Mg	meq/100g	3.3	12	4.8	7.8	8.6
Exchangeable Na	meq/100g	1.7	3.4	2.6	2.9	3.7
Cation Exchange Capacity	meq/100g	5.3	21	7.6	13	13
ESP	%	32	16	34	22	28

ESP/CEC		
Our Reference		396940-16
Your Reference	UNITS	138
Depth		0.5
Date Sampled		25/11/2025
Type of sample		Soil
Date prepared	-	05/12/2025
Date analysed	-	05/12/2025
Exchangeable Ca	meq/100g	15
Exchangeable K	meq/100g	0.3
Exchangeable Mg	meq/100g	8.8
Exchangeable Na	meq/100g	3.6
Cation Exchange Capacity	meq/100g	27
ESP	%	13

Misc Inorg - Soil						
Our Reference		396940-1	396940-2	396940-3	396940-4	396940-5
Your Reference	UNITS	101	106	109	113	116
Depth		0.5	0.5	0.4	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Chloride, Cl 1:5 soil:water	mg/kg	620	28	200	400	470
Sulphate, SO4 1:5 soil:water	mg/kg	370	36	82	110	320
pH 1:5 soil:water	pH Units	4.7	8.5	8.7	8.4	4.9

Misc Inorg - Soil						
Our Reference		396940-6	396940-7	396940-8	396940-9	396940-10
Your Reference	UNITS	116	118	118	120	127
Depth		1.3	0.5	1.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Chloride, Cl 1:5 soil:water	mg/kg	240	720	730	420	590
Sulphate, SO4 1:5 soil:water	mg/kg	220	460	460	130	310
pH 1:5 soil:water	pH Units	5.0	4.7	4.7	7.6	5.5

Misc Inorg - Soil						
Our Reference		396940-11	396940-12	396940-13	396940-14	396940-15
Your Reference	UNITS	130	130	135	135	135
Depth		0.5	1.5	0.5	1.0	1.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Chloride, Cl 1:5 soil:water	mg/kg	720	360	560	1,100	390
Sulphate, SO4 1:5 soil:water	mg/kg	270	240	170	290	130
pH 1:5 soil:water	pH Units	4.8	4.9	5.2	5.4	5.8

Misc Inorg - Soil						
Our Reference		396940-16	396940-17	396940-18	396940-19	396940-20
Your Reference	UNITS	138	102	103	104	105
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Chloride, Cl 1:5 soil:water	mg/kg	370	[NA]	[NA]	[NA]	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	160	[NA]	[NA]	[NA]	[NA]
pH 1:5 soil:water	pH Units	8.8	5.1	6.7	7.6	7.8

Misc Inorg - Soil						
Our Reference		396940-21	396940-22	396940-23	396940-24	396940-25
Your Reference	UNITS	107	108	110	111	112
Depth		0.5	0.4	0.4	0.4	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
pH 1:5 soil:water	pH Units	8.7	8.2	8.6	8.9	7.1

Misc Inorg - Soil						
Our Reference		396940-26	396940-27	396940-28	396940-29	396940-30
Your Reference	UNITS	114	115	117	119	121
Depth		0.5	0.4	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
pH 1:5 soil:water	pH Units	8.2	8.1	4.9	6.1	8.4

Misc Inorg - Soil						
Our Reference		396940-31	396940-32	396940-33	396940-34	396940-35
Your Reference	UNITS	122	123	124	125	126
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
pH 1:5 soil:water	pH Units	8.2	6.5	8.7	8.6	9.2

Misc Inorg - Soil						
Our Reference		396940-36	396940-37	396940-38	396940-39	396940-40
Your Reference	UNITS	128	129	131	132	133
Depth		0.5	0.4	0.4	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
pH 1:5 soil:water	pH Units	8.4	5.8	9.2	8.3	8.5

Misc Inorg - Soil						
Our Reference		396940-41	396940-42	396940-43	396940-44	396940-45
Your Reference	UNITS	134	136	137	139	140
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
pH 1:5 soil:water	pH Units	9.2	5.6	9.1	8.6	6.4

Misc Inorg - Soil						
Our Reference		396940-46	396940-47	396940-48	396940-49	396940-50
Your Reference	UNITS	101	101	113	116	117
Depth		1	1.5	0.9	1.0	1.0
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
Date analysed	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
pH 1:5 soil:water	pH Units	4.5	4.6	7.4	5.0	4.8

Misc Inorg - Soil						
Our Reference		396940-51	396940-52	396940-53	396940-54	396940-55
Your Reference	UNITS	117	118	118	119	120
Depth		1.5	1.0	2.0	1.0	0.7
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
Date analysed	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
pH 1:5 soil:water	pH Units	4.7	4.7	4.5	6.3	9.1

Misc Inorg - Soil						
Our Reference		396940-56	396940-57	396940-58	396940-59	396940-60
Your Reference	UNITS	122	130	133	134	134
Depth		1.0	1.0	1.0	1.0	1.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
Date analysed	-	04/12/2025	04/12/2025	04/12/2025	04/12/2025	04/12/2025
pH 1:5 soil:water	pH Units	8.5	6.3	7.9	8.9	8.4

Texture and Salinity*						
Our Reference		396940-1	396940-2	396940-3	396940-4	396940-5
Your Reference	UNITS	101	106	109	113	116
Depth		0.5	0.5	0.4	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	600	140	210	410	460
Texture Value	-	6.0	6.0	6.0	9.0	7.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	CLAY LOAM	MEDIUM CLAY
ECe	dS/m	3.6	<2	<2	3.7	3.2
Class	-	SLIGHTLY SALINE	NON SALINE	NON SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-6	396940-7	396940-8	396940-9	396940-10
Your Reference	UNITS	116	118	118	120	127
Depth		1.3	0.5	1.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	290	660	690	490	530
Texture Value	-	6.0	7.0	6.0	9.0	6.0
Texture	-	HEAVY CLAY	MEDIUM CLAY	HEAVY CLAY	CLAY LOAM	HEAVY CLAY
ECe	dS/m	<2	4.7	4.1	4.4	3.2
Class	-	NON SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-11	396940-12	396940-13	396940-14	396940-15
Your Reference	UNITS	130	130	135	135	135
Depth		0.5	1.5	0.5	1.0	1.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	570	350	470	770	340
Texture Value	-	7.0	6.0	7.0	7.0	6.0
Texture	-	MEDIUM CLAY	HEAVY CLAY	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY
ECe	dS/m	4.0	2.1	3.3	5.4	2.0
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	MODERATELY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-16	396940-17	396940-18	396940-19	396940-20
Your Reference	UNITS	138	102	103	104	105
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	440	820	890	430	460
Texture Value	-	6.0	7.0	7.0	6.0	6.0
Texture	-	HEAVY CLAY	MEDIUM CLAY	MEDIUM CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	2.6	5.7	6.2	2.6	2.7
Class	-	SLIGHTLY SALINE	MODERATELY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-21	396940-22	396940-23	396940-24	396940-25
Your Reference	UNITS	107	108	110	111	112
Depth		0.5	0.4	0.4	0.4	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	73	120	120	260	400
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	<2	<2	<2	<2	2.4
Class	-	NON SALINE	NON SALINE	NON SALINE	NON SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-26	396940-27	396940-28	396940-29	396940-30
Your Reference	UNITS	114	115	117	119	121
Depth		0.5	0.4	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	800	680	570	680	300
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	4.8	4.1	3.4	4.1	<2
Class	-	MODERATELY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	MODERATELY SALINE	NON SALINE

Texture and Salinity*						
Our Reference		396940-31	396940-32	396940-33	396940-34	396940-35
Your Reference	UNITS	122	123	124	125	126
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	750	360	89	320	320
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	4.5	2.2	<2	<2	<2
Class	-	MODERATELY SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		396940-36	396940-37	396940-38	396940-39	396940-40
Your Reference	UNITS	128	129	131	132	133
Depth		0.5	0.4	0.4	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	270	220	330	900	430
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	<2	<2	<2	5.4	2.6
Class	-	NON SALINE	NON SALINE	NON SALINE	MODERATELY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-41	396940-42	396940-43	396940-44	396940-45
Your Reference	UNITS	134	136	137	139	140
Depth		0.5	0.5	0.5	0.5	0.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Date analysed	-	03/12/2025	03/12/2025	03/12/2025	03/12/2025	03/12/2025
Electrical Conductivity	µS/cm	380	420	350	300	150
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	2.3	2.5	2.1	<2	<2
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		396940-46	396940-47	396940-48	396940-49	396940-50
Your Reference	UNITS	101	101	113	116	117
Depth		1	1.5	0.9	1.0	1.0
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Date analysed	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Electrical Conductivity	µS/cm	450	620	390	350	390
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	2.7	3.7	2.3	2.1	2.4
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-51	396940-52	396940-53	396940-54	396940-55
Your Reference	UNITS	117	118	118	119	120
Depth		1.5	1.0	2.0	1.0	0.7
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Date analysed	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Electrical Conductivity	µS/cm	330	750	560	410	360
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	<2	4.5	3.4	2.4	2.1
Class	-	NON SALINE	MODERATELY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		396940-56	396940-57	396940-58	396940-59	396940-60
Your Reference	UNITS	122	130	133	134	134
Depth		1.0	1.0	1.0	1.0	1.5
Date Sampled		25/11/2025	25/11/2025	25/11/2025	25/11/2025	25/11/2025
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Date analysed	-	02/12/2025	02/12/2025	02/12/2025	02/12/2025	02/12/2025
Electrical Conductivity	µS/cm	230	460	310	310	250
Texture Value	-	6.0	6.0	6.0	6.0	6.0
Texture	-	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY	HEAVY CLAY
ECe	dS/m	<2	2.8	<2	<2	<2
Class	-	NON SALINE	SLIGHTLY SALINE	NON SALINE	NON SALINE	NON SALINE

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-123	Determined using a "Texture by Feel" method.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-OES analytical finish.

QUALITY CONTROL: ESP/CEC					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	396940-5
Date prepared	-			05/12/2025	[NT]	[NT]	[NT]	[NT]	05/12/2025	05/12/2025
Date analysed	-			05/12/2025	[NT]	[NT]	[NT]	[NT]	05/12/2025	05/12/2025
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	95	110
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	107	109
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	98	102
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	[NT]	[NT]	[NT]	[NT]	119	115

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	396940-3
Date prepared	-			03/12/2025	1	03/12/2025	03/12/2025		03/12/2025	03/12/2025
Date analysed	-			03/12/2025	1	03/12/2025	03/12/2025		03/12/2025	03/12/2025
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	620	610	2	109	109
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	370	370	0	110	105
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	4.7	4.6	2	99	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	03/12/2025	03/12/2025		03/12/2025	[NT]
Date analysed	-			[NT]	11	03/12/2025	03/12/2025		03/12/2025	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	720	810	12	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	270	290	7	[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	4.8	4.8	0	99	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			[NT]	21	03/12/2025	03/12/2025		03/12/2025	[NT]
Date analysed	-			[NT]	21	03/12/2025	03/12/2025		03/12/2025	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	21	8.7	8.8	1	100	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	03/12/2025	03/12/2025		[NT]	[NT]
Date analysed	-			[NT]	31	03/12/2025	03/12/2025		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	31	8.2	8.3	1	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	03/12/2025	03/12/2025		[NT]	[NT]
Date analysed	-			[NT]	41	03/12/2025	03/12/2025		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	41	9.2	9.2	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	46	04/12/2025	04/12/2025		[NT]	[NT]
Date analysed	-			[NT]	46	04/12/2025	04/12/2025		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	46	4.5	4.5	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	56	04/12/2025	04/12/2025		[NT]	[NT]
Date analysed	-			[NT]	56	04/12/2025	04/12/2025		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	56	8.5	8.5	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			03/12/2025	1	03/12/2025	03/12/2025		03/12/2025	[NT]
Date analysed	-			03/12/2025	1	03/12/2025	03/12/2025		03/12/2025	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	<2	1	600	590	2	104	[NT]
Texture Value	-		INORG-123	[NT]	1	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	03/12/2025	03/12/2025		03/12/2025	[NT]
Date analysed	-			[NT]	11	03/12/2025	03/12/2025		03/12/2025	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	11	570	590	3	102	[NT]
Texture Value	-		INORG-123	[NT]	11	7.0	7.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	[NT]
Date prepared	-			[NT]	21	03/12/2025	03/12/2025		03/12/2025	[NT]
Date analysed	-			[NT]	21	03/12/2025	03/12/2025		03/12/2025	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	21	73	64	13	102	[NT]
Texture Value	-		INORG-123	[NT]	21	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	03/12/2025	03/12/2025		[NT]	[NT]
Date analysed	-			[NT]	31	03/12/2025	03/12/2025		[NT]	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	31	750	740	1	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	31	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	03/12/2025	03/12/2025		[NT]	[NT]
Date analysed	-			[NT]	41	03/12/2025	03/12/2025		[NT]	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	41	380	380	0	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	41	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	46	02/12/2025	04/12/2025		[NT]	[NT]
Date analysed	-			[NT]	46	02/12/2025	04/12/2025		[NT]	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	46	450	470	4	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	46	6.0	6.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	56	02/12/2025	03/12/2025		[NT]	[NT]
Date analysed	-			[NT]	56	02/12/2025	03/12/2025		[NT]	[NT]
Electrical Conductivity	µS/cm	2	Inorg-002	[NT]	56	230	260	12	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	56	6.0	6.0	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Air volumes are typically provided by customers (often as flow rate(s) and sampling time(s) and/or simply volumes) sampled or exposure times (determines 'volume' passive badges are exposed to)). Hence in such circumstances the volume measurement is inevitably not covered by Envirolab's NATA accreditation. An exception may occur where Envirolab Newcastle does the sampling where accreditation exists for certain types of sampling and hence volume determination(s). Note air volumes are often used to determine concentrations for dust and/or analyses on filters, sorbents and in impingers. For canister sampling, the air volume is covered by Envirolab's NATA accreditation.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates can be downloaded from the Envirolab Resources website or obtained directly by contacting the laboratory.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

For Dust Deposit Gauge (DDG) analysis the sampling, sampling period and funnel exposure area do not fall under Envirolab's NATA accreditation (unless the Newcastle laboratory where responsible for the sampling), hence the annotation on the DDG units of reporting.

Urine Analysis - The BEI values listed are taken from the 2022 edition of "TLVs and BEIs Threshold Limits" by ACGIH.

Table D1: Summary Table - Laboratory Tests and Assessments

Test Location	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					Exchangeable Sodium (Na) Concentration	Cation Exchange Capacity	Sodicity	Sodicity Class	Emerson Class Number	Dispersion?	Soil Texture Group	Textural Factor (M)	$EC_{1:5}$	EC_e	Sample Salinity Class
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity			[Na/CEC]			(from Emerson Class)	(for detailed soil logs see Report Appendix)		[Lab.]	[M x $EC_{1:5}$]	(Based on sample ECe)
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					(meq/100g)	(meq/100g)	(%)	[after DLWC]		[AS1289.3.8.1]	[after DLWC]	[after DLWC]	(microS/cm)	(deciS/m)	[Richards 1954]
101	0.5	4.7	620	370	1667	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild	1.7	5	32	Highly Sodic	2	Some	Heavy clay	6	600	3.6	Slightly Saline
101	1	4.5			2222	B	Moderate		Non-Aggressive		Non-Aggressive							Heavy clay	6	450	2.7	Slightly Saline
101	1.5	4.6			1613	B	Mild		Non-Aggressive		Mild							Heavy clay	6	620	3.7	Slightly Saline
102	0.5	5.1			1220	B	Mild		Non-Aggressive		Mild							Medium clay	7	820	5.7	Moderately Saline
103	0.5	6.7			1124	B	Non-Aggressive		Non-Aggressive		Mild							Medium clay	7	890	6.2	Moderately Saline
104	0.5	7.6			2326	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	430	2.6	Slightly Saline
105	0.5	7.8			2174	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	460	2.8	Slightly Saline
106	0.5	8.5	28	36	7143	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	140	0.8	Non-Saline
107	0.5	8.7			13699	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	73	0.4	Non-Saline
108	0.4	8.2			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	120	0.7	Non-Saline
109	0.4	8.7	200	82	4762	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	3.4	21	16	Highly Sodic			Heavy clay	6	210	1.3	Non-Saline
110	0.4	8.6			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	120	0.7	Non-Saline
111	0.4	8.9			3846	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	260	1.6	Non-Saline
112	0.5	7.1			2500	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	400	2.4	Slightly Saline
113	0.5	8.4	400	110	2439	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Clay loam	9	410	3.7	Slightly Saline
113	0.9	7.4			2564	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	390	2.3	Slightly Saline
114	0.5	8.2			1250	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	800	4.8	Moderately Saline
115	0.4	8.1			1471	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	680	4.1	Moderately Saline
116	0.5	4.9	470	320	2174	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	2.6	8	34	Highly Sodic			Medium clay	7	460	3.2	Slightly Saline
116	1.3	5	240	220	3448	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Heavy clay	6	290	1.7	Non-Saline
116	1	5			2857	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	350	2.1	Slightly Saline
117	0.5	4.9			1754	B	Mild		Non-Aggressive		Mild							Heavy clay	6	570	3.4	Slightly Saline
117	1	4.8			2564	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	390	2.3	Slightly Saline
117	1.5	4.7			3030	B	Mild		Non-Aggressive		Non-Aggressive							Heavy clay	6	330	2.0	Non-Saline
118	0.5	4.7	720	460	1515	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Medium clay	7	660	4.6	Moderately Saline
118	1.5	4.7	730	460	1449	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild							Heavy clay	6	690	4.1	Moderately Saline
118	1	4.7			1333	B	Mild		Non-Aggressive		Mild							Heavy clay	6	750	4.5	Moderately Saline
118	2	4.5			1786	B	Moderate		Non-Aggressive		Mild							Heavy clay	6	560	3.4	Slightly Saline
119	0.5	6.1			1471	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	680	4.1	Moderately Saline
119	1	6.3			2439	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	410	2.5	Slightly Saline
120	0.5	7.6	420	130	2041	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive							Clay loam	9	490	4.4	Moderately Saline
120	0.7	9.1			2778	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	360	2.2	Slightly Saline
121	0.5	8.4			3333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	300	1.8	Non-Saline
122	0.5	8.2			1333	B	Non-Aggressive		Non-Aggressive		Mild							Heavy clay	6	750	4.5	Moderately Saline
122	1	8.5			4348	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	230	1.4	Non-Saline
123	0.5	6.5			2778	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	360	2.2	Slightly Saline
124	0.5	8.7			11236	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	89	0.5	Non-Saline
125	0.5	8.6			3125	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	320	1.9	Non-Saline
126	0.5	9.2			3125	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	320	1.9	Non-Saline
127	0.5	5.5	590	310	1887	B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive	Mild	2.9	13	22	Highly Sodic			Heavy clay	6	530	3.2	Slightly Saline
128	0.5	8.4			3704	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	270	1.6	Non-Saline
129	0.4	5.8			4545	B	Non-Aggressive		Non-Aggressive		Non-Aggressive							Heavy clay	6	220	1.3	Non-Saline

Appendix E

CSIRO Publication

FOUNDATION MAINTENANCE AND FOOTING PERFORMANCE

Preventing soil-related building movement

This Building Technology Resource is designed as a homeowner's guide on the causes of soil-related building movement, and suggested methods to prevent resultant cracking.

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 home owner 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. Generally soil classification is provided by a geotechnical report.

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.

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. Table 1 below is a reproduction of Table 2.1 from Australian Standard AS 2870-2011, Residential slabs and footings.

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 may be the province of the builder and should be taken into consideration as part of the preparation of the site for construction.

EROSION

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

SATURATION

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

SEASONAL SWELLING AND SHRINKAGE OF SOIL

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below, from AS 2870). 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.

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.

TABLE 1. GENERAL DEFINITIONS OF SITE CLASSES.

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Source: Reproduced with the permission of Standards Australia Limited © 2011. Copyright in AS 2870-2011 Residential slabs and footings vests in Standards Australia Limited.

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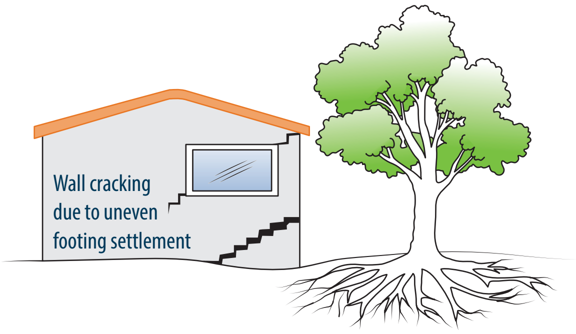

FIGURE 1 Trees can cause shrinkage and damage.

- 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 through absorption. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Shrinkage usually begins on the side of the building where the sun's heat is greatest.

EFFECTS OF UNEVEN SOIL MOVEMENT ON STRUCTURES

EROSION AND SATURATION

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

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

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

SEASONAL SWELLING/SHRINKAGE IN CLAY

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

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

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

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

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

MOVEMENT CAUSED BY TREE ROOTS

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

COMPLICATIONS CAUSED BY THE STRUCTURE ITSELF

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

EFFECTS ON FULL MASONRY STRUCTURES

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

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

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

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

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

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also

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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 causes 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. Table 2 below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 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 AND 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 may 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 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.

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.

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TABLE 2. CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS.

Description of typical damage and required repair	Approximate crack width limit	Damage category
Hairline cracks	<0.1 mm	0 – Negligible
Fine cracks which do not need repair	<1 mm	1 – Very Slight
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2 – Slight
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 – Moderate
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 depends on number of cracks	4 – Severe

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Warning: Although this Building Technology Resource 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, and mould.
- 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

Existing trees may cause problems with the upheaval of footings by their roots, or shrinkage from soil drying. 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. Soil drying is a more complex issue and professional advice may be required before considering the removal or relocation of the tree.

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.

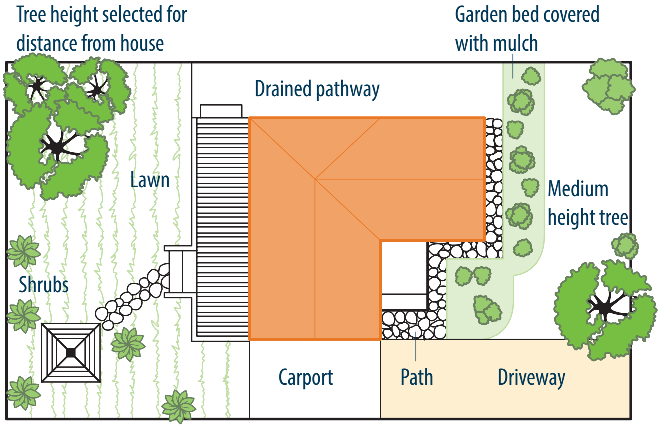

FIGURE 2 Gardens for a reactive site.

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 home owner 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.

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