GEOTECHNICAL INVESTIGATION REPORT

Proposed Concept Plan Approval Modification

CLIENT

Walker Rosedale

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DATE

February 2024

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Our ref: EM/C14934

Walker Rosedale

Via email: dean.davies@walkercorp.com.au

Proposed Concept Plan Approval Modification
Bevian Road, Rosedale, NSW
Geotechnical Investigation Report

We are pleased to present our geotechnical investigation report to support modification of the 2008 Concept Plan Approval for a residential subdivision at Bevian Road, Rosedale, NSW.

The report outlines the methods and results of exploration, describes site subsurface conditions and provides recommendations for building footing design, excavation conditions, excavation support, preparation of subgrades, stability of cut and fill batters, retaining wall design, earthquake classification and site drainage advice.

Should you require any further information regarding this report, please do not hesitate to contact our office.

Yours faithfully
Fortify Geotech

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About us

We work with our clients to provide practical advice and solutions tailored to each project. Our professional services are reliable, responsive and efficient.

Our highly capable Geotechnical Engineers and Geologists have a comprehensive understanding of the industry. We provide the best engineering solution for complicated geotechnical engineering issues. This has earned us a solid reputation with our Construction Industry, Municipal and Government clients.

INDUSTRIES WE WORK IN

- Residential
- Commercial
- Transport Infrastructure
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SERVICES

- Geotechnical Site Investigations and Reporting;
- Engineering Geology;
- Mining/Rock Geotechnics;
- Foundation Engineering;
- Dam Engineering; Embankment Design and Specification;
- Geotechnical Design Recommendations;
- Pavement Engineering and Design;
- Pavement Condition Surveys;
- Slope Stability and Risk Assessments;
- Geotechnical and Hydrological Instrumentation and Monitoring;
- Footing and Excavation Supervision and Certifications;
- Excavated soil/rock assessments and VENM assessments;
- Supervision and Certification of Earthworks and Controlled Fill, including Level 1 supervision;
- Geotechnical Construction Specifications;
- Deep Excavation Support; and
- Slope/Retaining Structure Analysis and Design

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QUALITY INFORMATION

Revision history

Reference/ Revision	Description	Date	Author	Reviewer
EM/C14934 Rev0	For issue – Geotechnical Investigation Report	22/02/2024	EM	JM
JM/C14934 Rev1	For issue – Geotechnical Investigation Report	22/02/2024	EM	JM
JM/C14934 Rev2	For issue – Geotechnical Investigation Report	22/04/2024	EM	JM
JM/C14934 Rev3	For issue – Geotechnical Investigation Report	05/07/2024	EM	JM

Walker Rosedale

Proposed Concept Plan Approval Modification at Bevian Road, Rosedale, NSW

Geotechnical Investigation Report

1 INTRODUCTION

At the request of the client, Fortify Geotech Pty Ltd carried out a geotechnical investigation to support a proposed modification of the 2008 Concept Plan Approval for a residential subdivision at Bevian Road, Rosedale, NSW.

The modification sought is from the Part 3A Concept Approval for a Community Title Subdivision for residential development and ancillary commercial and community facilities, ecological stewardship, public roads and open space areas yielding a total of 792 residential lots (reference number 05_0199), to a Torrens title development that includes residential development and ancillary commercial facilities, public roads, public open areas and residual rural lot yielding a total of 792 residential lots inclusive of the 51 Torrens title residential lots recently constructed and registered as part of stage 1 (DA305/18). Some cut-to-fill earthworks of up to a maximum of 7m depth cut and 5m height fill are expected on the undulating site (Appendix E; Bulk Earthwork Cut and Fill Plan, 210123-00-C-C04.01). A number of on-site stormwater detention basins will also be constructed. Given the undulating topography, a slope stability risk assessment was also undertaken.

The aim of the investigation was to:

(i) Identify subsurface conditions including the extent and nature of any fill materials, soil strata, bedrock type and depth, and groundwater presence.

(ii) Results of laboratory testing of site soils for acid sulphates, particle size distribution & plasticity, compaction & soaked CBR, and permeability.

(iii) Provide site classification to AS2870 “Residential Slabs & Footings”.

(iv) Advise on suitable footings systems, founding depths, allowable/ultimate bearing pressures and design parameters for ground slabs.

(v) Advise on excavation conditions and suitability of excavated material for use as structural fill.

(vi) Advise for temporary excavation support.

(vii) Provide guidelines for construction of controlled fill platforms.

(viii) Advise on stable batter slopes and retaining wall design parameters.

(ix) Provide earthquake classification of this site.

(x) Provide a groundwater assessment, including presence of groundwater and groundwater inflow rates, and advice on site drainage and groundwater control during and post construction.

(xi) Landslide and slope stability risk assessment.

2 SITE DESCRIPTION & GEOLOGY

2.1 SITE LOCATION AND SITE DESCRIPTION

The site is bounded by George Bass Drive to the south, Mogo State Forest to the west, Bevian Road to the north, and Bevian Road and Roseby Drive to the east. Except for the recently completed and registered Stage 1 consisting of 51 Torrens title residential lots (refer DP 1293369), the site is largely undeveloped and is a mix of former grazing land and undisturbed bushland, and the ground surface is grass-covered with scattered trees. Appendix E at the end of this report shows the concept subdivision plan (Drawing AA_01, June 2024).

2.2 TOPOGRAPHY AND DRAINAGE

The topography of the site typically falls from west to east with a gentle slope from north to south toward Barling's beach. There is a ridge in the middle part of the site that stretches from east to west. The ground surface dipping from ~RL80 in the NW corner to ~RL15 in the SE corner. Figure 2 is a recent satellite image showing the present site layout. Drainage in site is expected to be through Saltwater Creek and its tributaries which drain in an easterly direction through the middle of the site, as well as south into the existing Bevian wetland before discharging towards Barlings Beach.

2.3 REGIONAL GEOLOGY

The site is documented in the Eurobodalla 1:10,000 Coastal Quaternary Geology Map Series as being underlain by Ordovician age Wagonga Group bedrock, including chert, conglomerate, siltstone, sandstone, basic volcanic rocks. Figure 3 shows an extract of the geology map. The bedrock is covered by Holocene age alluvial deposits of silt, very fine- to medium-grained lithic to quartz-rich sand, and clay in areas close to creek and gully alignments.

3 INVESTIGATION METHODS

The current field investigation was carried out between 14 to 16 January 2024, comprising twenty-four (24) augered and cored boreholes. This included four (4) cored boreholes, designated BH1-1 to BH4-1, drilled to 7.0m depth, and twenty (20) auger boreholes, designated BH1 to BH20, drilled to 3m depth or shallower refusal in medium strength bedrock. The cored boreholes were drilled by a track mounted Hanjin D&B 8D drill rig, with the soils were augered using a 100mm continuous auger, and the bedrock diamond-cored using NMLC techniques. Core retrieved from the boreholes was placed in metal core trays.

Thirteen (13) representative samples of the site soils and bedrock were taken and tested for compaction & soaked CBR, particle size distribution, Atterberg Limits, Emerson Dispersion, Permeability and Chromium Reducible Sulphur (acid sulphates) in a NATA laboratory.

The borehole locations are shown on Figure 2 at the end of this report. Borehole logs are presented in Appendix A, while photos of the core are attached to the end of the report.

The auger profiles were visually logged in accordance with the Unified Soil Classification System (USCS) and AS1726-2017. Definitions of geotechnical engineering terms used on the logs and in this report, including a copy of the USCS chart, are provided in Appendix B. A Dial Before You Dig (DBYD) underground service search was conducted for the nominated borehole locations and surrounding area prior to the fieldwork.

4 INVESTIGATION RESULTS

4.1 SUBSURFACE CONDITIONS

The subsurface conditions of the proposed development were investigated by twenty-four (24) augered and cored boreholes. In summary, the results of the investigation indicate that the subsurface profile across the site comprises topsoil, then alluvial clayey soil, underlain by residual soil and weathered chert/siltstone bedrock.

The subsurface profile as found in boreholes BH1-1 to BH4-1 (cored boreholes) and BH1 to BH20 (augered boreholes) is summarised in Table 4-1. The engineering logs are included in Appendix A and can be referred to for more detail.

Table 4-1: Subsurface Profile Summary

Geological Profile	Typical Depth Interval	Description
TOPSOIL	0m to 0.10m/0.20m	**Silty CLAY:** low plasticity, dark brown, trace of root fibres, moist equal to plastic limit, soft.
ALLUVIAL SOIL	0.10m/0.20m to 0.4m/0.8m	**Sandy CLAY:** low plasticity, brown, red brown, red mottled, fine to coarse sand, moist equal to plastic limit, firm to stiff. (Only in BH8, BH9 and BH17)
	0.10m/0.20m to 0.4m/1.5m	**Gravelly CLAY/ Gravelly sandy CLAY:** low plasticity, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, fine to coarse sand, moist equal to plastic limit, firm to stiff.
	0.2m/1.5m to 0.4m/2.0m	**Silty CLAY/Sandy silty CLAY**: low plasticity clay, pale brown, pale grey, moist equal to plastic limit, stiff.
RESIDUAL SOIL	0.5m/2.5m to 0.8m/3.5m	**Silty clayey SAND/Clayey SAND/ Clayey gravelly SAND**: fine to coarse sand, red brown, pale grey, low plasticity clay, fine to coarse, angular to sub-angular gravel, moist, medium dense
WEATHERED BEDROCK	Below 0.4m/3.5m	**CHERT**: Extremely (XW) to Moderately (MW) weathered, fine-grained, thin bedded, some fine-grained sandstone and mudstone interlayers, white, blue grey, pale grey, dry to moist, low to medium strength. **SILTSTONE**: Highly (HW) to Moderately (MW) weathered, fine grained, blue grey, grey, thin bedded, low to medium strength rock.

The depth to bedrock varies from 0.4m depth (~RL13.6) at boreholes BH14 on the ridge in the centre of the site, to 3.5m depth (~RL21.0) at borehole BH9 in the NW side of the site. The location of the sections is shown in Figure 2.

Weathered siltstone/chert bedrock is generally expected within 1m/2m depth on the higher ground, but extends to 3.5m depth on lower-lying ground. The 7m maximum depth cuts are expected to encounter low to medium strength, extremely to highly weathered (EW/HW), highly weathered (HW), highly to moderately weathered (HW/MW), and moderately weathered (MW) bedrock.

Table 4-2: Depth of Unsuitable Material, RL's of Groundsurface, Bedrock Surface, and Depth to Auger Refusal

Bore hole No.	Ground surface RL	Borehole depth	Depth to XW & XW/HW Bedrock /RL	Depth to HW & MW Bedrock / RL	Depth of Unsuitable Material (e.g. Topsoil)	Depth to Auger Refusal
BH1-1	56.0	7.0	0.6/55.4	2.8/53.2	0.2	1.8
BH2-1	57.0	7.0	1.0/56.0	4.0/53	0.2	4.0
BH3-1	45.0	7.0	0.6/44.4	2.5/42.5	0.1	1.0
BH4-1	44.0	7.0	0.9/43.1	4.85/39.15	0.1	2.6
BH1	42.0	1.1	0.8/41.2	Not encountered	0.15	1.1
BH2	36.0	1.8	1.7/34.3	Not encountered	0.2	1.8
BH3	26.0	3.0	2.5/23.5	Not encountered	0.3	3.0
BH4	34.0	1.4	1.2/32.8	Not encountered	0.15	1.4
BH5	21.0	3.8	3.5/17.5	Not encountered	0.2	3.8
BH6	36.0	2.0	1.8/34.2	Not encountered	0.2	2.0
BH7	35.0	1.8	1.4/33.6	Not encountered	0.2	1.8
BH8	50.0	2.4	2.2/47.8	Not encountered	0.2	2.4
BH9	36.0	1.5	1.2/34.8	Not encountered	0.15	1.5
BH10	28.0	2.0	1.8/26.2	Not encountered	0.2	2.0
BH11	50.0	0.9	0.8/49.2	Not encountered	0.15	0.9
BH12	59.0	0.5	0.4/58.6	Not encountered	0.2	1.2
BH13	42.0	1.7	1.5/40.5	Not encountered	0.15	1.7
BH14	14.0	0.6	0.4/13.6	Not encountered	0.2	0.6

Bore hole No.	Ground surface RL	Borehole depth	Depth to XW & XW/HW Bedrock /RL	Depth to HW & MW Bedrock / RL	Depth of Unsuitable Material (e.g. Topsoil)	Depth to Auger Refusal
BH15	12.0	1.4	1.2/10.8	Not encountered	0.2	1.4
BH16	39.0	1.5	1.2/38.7	Not encountered	0.2	1.5
BH17	36.0	2.2	2.0/34.0	Not encountered	0.1	2.2
BH18	29.0	1.0	0.8/28.2	Not encountered	0.1	1.0
BH19	16.0	3.0	2.5/13.5	Not encountered	0.15	3.0
BH20	25.0	2.0	1.8/23.2	Not encountered	0.2	2.0

4.2 GROUNDWATER

No free groundwater was encountered during the augering and drilling phase of each borehole, and the use of water as a drilling fluid precluded groundwater observations during the coring of the bedrock.

Based on current and previous investigations in this area, depth of groundwater is expected at ~5m below the existing groundsurface in the lower-lying parts of the site and at ~10m below the existing groundsurface in the upper slopes of the site. It is our assessment that the permanent groundwater level is at about RL7.0 to RL50.0. Given that the proposed lowest cut floor will be at ~RL12, dewatering is unlikely be required for this project. However, temporary, perched seepages could be encountered at shallower depth following rainfall.

4.3 LABORATORY TEST RESULTS

4.3.1 Chromium Reducible Sulfur

Results of the Chromium Reducible Sulfur testing is summarized in Table 5below. Full details are provided on the NATA test certificates in Appendix B.

Table 4-3: Chromium Reducible Sulfur Test Results

Test Hole Number Depth (m)	Unit	BH3 1.2m-2.0m	BH8 1.5m-2.0m	BH12 0.5m-1.0m	BH20 1.0m-1.8m
pH kcl	pH units	3.8	4.1	3.5	4.1
s-TAA pH 6.5	%w/w S	0.06	0.02	0.08	0.04
TAA pH 6.5	moles H+/t	36	14	49	23
Chromium Reducible Sulfur	%w/w	0.007	0.008	<0.005	0.08

Test Hole Number **Depth (m)**	**Unit**	**BH3** 1.2m-2.0m	**BH8** 1.5m-2.0m	**BH12** 0.5m-1.0m	**BH20** 1.0m-1.8m
a-Chromium Reducible Sulfur	moles H+/t	4	5	<3	51
s-Net Acidity	%w/w S	0.094	0.045	0.12	0.14
a-Net Acidity	moles H+/t	54	26	70	86
Liming rate	kg CaCO3/t	4	2	5	6
a-Net Acidity without ANCE	moles H+/t	54	26	70	86
Liming rate without ANCE	kg CaCO3/t	40	20	5.2	6.4
s-Net Acidity without ANCE	%w/w S	0.086	0.042	0.11	0.14

The pH of the samples was between 3.5 and 4.1 showing the site soils to be acidic. The values of Chromium Reducible Sulfur indicate that acid sulphate soils could be present. The testing indicates that the neutralizing value of pure CaCO3 for the soil is in the range of 5.2 to 40 kg/t, and some treatment of acidic soils during earthworks will be required. It is understood that an environmental consultant will be providing further advice in regards to the soil treatment required for acid sulphate soils.

4.3.2 Emerson Testing

The dispersion determination of Emerson class number test (AS 1289.3.8.1-2006) was carried out on the samples taken from BH12 and BH21 the results of which show the soil is classified as Class 1 with complete dispersion. This indicates that the soils are dispersive and prone to erosion, and erosion protection measures will be required. Erosion protection measures should ensure that there are no bare soils, so vegetation (hydroseeding) or hardstand can be used. On slopes steeper than 3(H):1(V), geofabrics such as ‘JuteMesh’ would be required.

4.3.3 Particle Size Distribution, Atterberg Limits and Permeability Testing

Two (2) samples of the site soils were tested in a NATA lab for particle size distribution, Atterberg limits, standard compaction, and Atterberg limits testing. The results are summarised below, and the test certificates are included in Appendix B.

Table 4-4: Particle Size Distribution and Atterberg Limits Test Results

Test Hole Number	BH3	BH18
Depth (m)	1.2m-2.0m	0.2m-0.8m
Material Description	Silty CLAY	Sandy CLAY
% Passing 2.36mm	94	76
% Passing 0.075mm	81	58
Liquid Limit (%)	48	37
Plastic Limit (%)	22	22
Plasticity Index (%)	26	15
Linear Shrinkage (%)	11	7

4.3.4 Permeability Testing

Two representative samples of the site alluvial clay soils were sampled from BH3 and BH10 and tested in a NATA lab for falling head permeability. The results are summarised below, and the test certificates are included in Appendix B.

Table 4-5: Permeability Test Results

Test Hole Number	Unit	BH3	BH10
Depth (m)		1.2m-2.0m	1.2m-1.6m
Permeability	m/sec	8x10^{-11}	2x10^{-10}

Therefore, the cut stormwater detention basin floors and sides in alluvial silty clay soils of the site or well compacted fill material sourced from onsite excavated material are expected to be relatively impervious. Where basins are constructed in fill, they must have a 300mm thick liner of similar impervious clay material.

4.3.5 California Bearing Ratio (CBR) Testing

Four (4) representative samples of the soil from auger, were sampled on 15 January 2024, and tested in a NATA laboratory for modified compaction and four-day soaked CBR value.

Results of modified compaction and soaked CBR laboratory tests performed on the subgrade soils are summarised in Table 4-4. The CBR test specimens were compacted to a nominal 98%ModMDD at about optimum moisture content and soaked for four days prior to testing. The NATA certificates are attached.

Table 4-6: Laboratory CBR Test Results Summary

Sample No.	BH5	BH9	BH12	BH20
Depth	1.0m – 1.5m	0.2m – 0.6m	0.5m – 1.0m	1.0m – 1.8m
Material Description	Gravelly CLAY	Sandy CLAY	Gravelly Sandy CLAY	Silty Clayey SAND
CBR Value (4-day soak) (%)	**2**	**4**	**1**	**1.5**

The samples from BH5, BH9 and BH12 comprise clayey alluvial soil while the sample from BH20 comprises sandy residual soil. The testing indicates that the site soils have a low soaked CBR value, and design CBR values for pavement design are discussed in section 5.10.

4.3.6 Point Load Strength Testing

Point-load strength index tests were carried out on selected representative rock specimens given from test pits. The index values were used to derive the approximate compressive strength of the rock by applying the empirical relationship qu = 24 x Is(50), where qu is the ultimate compressive strength. The results of the testing are tabulated in Appendix B. Table 4 is summarised the estimated compressive strengths of the siltstone bedrock of the investigated site.

Table 4-7: Estimated Rock Compressive Strengths

Rock Weathering Grade	Estimated Compressive Strength (MPa)		No. of Point Load Tests	Rock Material Strength Classification (1)
	Range	Average		
HW/MW Chert/Siltstone	11-43	20	10	‘Medium’ to ‘High’ Strength

Considering that the cores of the upper XW bedrock were crushed or a low RQD value, it was not possible to prepare a suitable sample for point load test from this part of bedrock. The HW/MW bedrock would have compressive strengths generally less than 20 MPa in Siltstone and 40 MP in Chert. Intact compressive strengths between 11MPa and 43MPa can be expected for the HW and HW/MW Siltstone and Chert.

5 DISCUSSION & RECOMMENDATIONS

5.1 GEOTECHNICAL PARAMETERS

Table 5-1 shows the estimated geotechnical parameters of the soil/rock units based on our visual assessment.

Table 5-1: Estimated Geotechnical Parameters

Unit	Typical Interval Depth	Bulk Density γ_b (kN/m^3)	C (kPa)	Ø' (degrees)	Young's Modulus (MPa)	Poisson's Ratio	K_a	K_o	K_p
Alluvial Soil	0.1/0.2m – 0.4/2.0m	18	15	25	20	0.4	0.41	0.58	2.5
Residual Soil	0.5/2.5m – 0.8/3.5m	20	5	28	30	0.35	0.36	0.53	2.77
XW Bedrock	0.4/3.5m – 2.5/4.8m	22	25	30	100	0.3	0.33	0.50	3.0
HW Bedrock	2.5/4.8m – Bellow 7m	24	50	35	200	0.3	0.27	0.43	3.7

Where,

γ_b = in-situ, dry unit weight, in kN/m^3
Cu = undrained cohesion, in kPa
C' = effective drained cohesion, in kPa
Ø' = effective internal friction angle, in degrees
K_a = active pressure coefficient
K_0 = at rest coefficient
K_p = passive pressure coefficient

The above values can be used in software programs for footing and retaining wall design; however, it is recommended that the values for lateral earth pressures in Section 5.5 be used as a minimum in retaining wall design.

5.2 SITE CLASSIFICATION

The characteristic ground surface movement "Ys", as defined by AS2870 for the range of extreme dry to extreme wet moisture conditions is estimated, with consideration given to the reactivity of the sub-soils, to be between 20mm to 40mm. Therefore it is assessed that footings equivalent to that of a Class "M" (moderately reactive) site will be appropriate. Site classifications must be carried out for each individual lot at the conclusion of site earthworks and include at least one borehole on each lot.

Should earthworks (cut or fill) be undertaken on the site, or other activities which may cause abnormal moisture conditions to impact the soils within or near the building envelope beyond those addressed herein, the site classification shall be reassessed.

5.3 BUILDING FOOTINGS & GROUND SLABS

AS2870 provides “deemed-to-comply” footing/slab designs, which for a class “M” site includes stiffened rafts, stiffened footing slabs, waffle rafts, and strip and/or pad footings with above ground floors. Footings and slabs should be in accordance with the principles of AS2870.

For structures founded at existing grade, footings, including thickened sections of slabs forming footings should be founded in the medium dense or very stiff alluvial/residual soil or weathered bedrock. A depth of ~0.3m from existing levels may be required to reach a suitable founding stratum. Shallow footings could be founded in any newly placed controlled fill following removal of any uncontrolled fill material (see Section 5.6). Alternatively, footings could be founded on piers extending to bedrock below ~0.4m/3.5m depth.

For limit state design a geotechnical reduction factor (ϕg) is to be applied to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 5-2 to derive the design ultimate geotechnical pile capacity. If designing footings based on engineering principles, recommended allowable and ultimate end-bearing pressures for various footing systems and likely foundation materials are provided in Tables 5-2 and 5-3.

In accordance with AS2159-2009, ϕg is dependent on assignment of an Average Risk Rating (ARR) which takes into account various geotechnical uncertainties, redundancy of the foundation system, construction supervision, and the quantity and type of pile testing. The assessment of ϕg therefore depends on the structural design of the foundation system as well as the design and construction method, and testing (if any) to be employed by the designer and piling contractor. For preliminary design, and in the absence of details of the proposed pile design and verification, we recommend that a ϕg value of 0.45 be adopted.

Table 5-2: Recommended Allowable End-Bearing Pressures for Footings

Foundation Material Type	Depth Below Existing Surface	Allowable End-Bearing Pressure			Allowable Shaft Resistance on Piles	
		Strips	Pads	Piles	Downward Loading	Uplift
Alluvial Soils stiff/ dense or better	0.1/0.2m – 0.4/3.5m	125kPa	150kPa	200kPa	20kPa	10kPa
XW & XW/HW Siltstone Bedrock	0.4/3.5m – 2.5/4.8m	500kPa	600kPa	750kPa	75kPa	30kPa
HW/MW & MW Siltstone Bedrock (1)	2.5/4.8m – Below 7m	1000kPa	1500kPa	2000kPa	200kPa	100kPa

1 This rock is unlikely to be encountered within the proposed exavation depths and is unlikely to be consistent enough in a lateral or vertical direction to provide a reliable foundation material.

Table 5-3: Recommended Ultimate End-Bearing Pressures for Footings

Foundation Material Type	Depth Below Existing Surface	Allowable End-Bearing Pressure			Allowable Shaft Resistance on Piles	
		Strips	Pads	Piles	Downward Loading	Uplift
Alluvial Soils stiff/ dense or better	0.1/0.2m – 0.4/3.5m	375kPa	450kPa	600kPa	60kPa	30kPa
EW & EW/HW Siltstone Bedrock	0.4/3.5m – 2.5/4.8m	1500kPa	1800kPa	2250kPa	225kPa	90kPa
HW/MW & MW Siltstone Bedrock (1)	2.5/4.8m – Below 7m	3000kPa	4500kPa	6000kPa	600kPa	300kPa

1 This rock is unlikely to be encountered within the proposed excavation depths and is unlikely to be consistent enough in a lateral or vertical direction to provide a reliable foundation material.

All footings should be inspected and approved by an experienced geotechnical engineer to confirm the foundation material and design values, and to ensure the excavations are clean and stable.

Ground slabs can be constructed on the natural soils or newly placed controlled fill, following the removal of any topsoil, and fill material. Following excavation to required level, slab areas on soil should be test rolled by a roller with a static mass of at least 10 tonnes to check for any weak, wet or deforming soils that may require replacement. Suitable replacement fill should be compacted in not thicker than 150mm layers to not less than 95%ModMDD. If required for design of ground slabs, a modulus of subgrade reaction of 30kPa/mm can be assumed for a natural soil or controlled fill foundation, and 100kPa/mm for a bedrock foundation.

5.4 EXCAVATION CONDITIONS AND EXCAVATION SUPPORT

5.4.1 Excavation Conditions

The development will have some cut-to -fill earthworks of up to maximum 7m depth cut. Such excavations would require excavation through alluvial/residual soils into chert/siltstone bedrock of ‘Low’ to “Medium’ strength. The alluvial soils and XW/HW, HW and HW/MW bedrock can be dug by a medium to large excavator. However, MW and less-weathered bedrock, which is expected to be encountered below about 2.5m/4.5m depth, will require heavy excavator or dozer (D8 or D9) ripping, and heavy rock hammering. The depth to refusal in the auger holes indicates the depth that ripping/rock hammering is expected to be required. Table 4-2 in Section 4.1 provides the expected depth of fill, depth to bedrock, and auger refusal depth at each borehole location.

Drilling of soldier pier holes could be conducted using a large piering rig (such as a ‘Soilmec’), of at least 50 tonnes.

5.4.2 Use of Excavated Material

The low and medium plasticity alluvial soils can be used in controlled fill, with a design CBR value of 3%. The weak to medium strong chert/siltstone bedrock is expected to break down to a clayey sandy gravel or gravelly clayey sand with a CBR value greater than 8%, and is expected to make an excellent select fill material, although rock particles should be broken down to less than 75mm size. The high plasticity clays should not be used in controlled fill but can be used in non-structural applications such as clay capping in dams/stormwater detention ponds or municipal tips. The topsoil and silty slopewash soils are not suitable for use in controlled fill.

If imported fill is required, a suitable select fill material would include a low or medium plasticity soil such as clayey sand or gravelly clayey sand, containing between 25% and 50% fines less than 0.075mm size (silt and clay), and no particles greater than 75mm size.

5.5 STABILITY OF CUT BATTERS

5.5.1 Temporary Excavation Support (Shoring) Options

Temporary excavation batters to less than 1.5m depth can be formed vertically, although loose topsoil/fill must be battered back at 1(H):1(V). Cuts deeper than 1.5m depth should be formed no steeper than 0.5(H):1(V) in soil and XW to HW bedrock provided the overall height is not greater than 5m. Steeper cuts (say 0.25(H):1(V)) may be acceptable in less-weathered siltstone but this would need to be assessed by a geotechnical engineer during construction and will depend on the degree of fracturing of the rock, orientation of rock joints, and other defects, and on the extent of groundwater seepage. Higher batters are unlikely to be suitable and would require detailed assessment. The batter slope surfaces would need to be temporarily stabilised against deterioration and fretting by covering in plastic and chain-link mesh held in place by anchor pins.

Where space limitations preclude battering back, or where backfilled services trenches may be located close behind the proposed batter faces, or where the excavation may be within the zone of influence of either structures or roads, temporary support (shoring) options include reinforced shotcrete stabilisation and shoring boxes.

5.6 DESIGN PARAMETERS FOR EXCAVATION SUPPORT SYSTEMS

Calculation of lateral earth pressures in the design of excavation supports and/or for permanent basement walls will need to take account of the following applied loadings: soil/rock pressures:

1) surface surcharges

2) groundwater hydrostatic pressure

3) footings loads of adjacent structures

A permanent groundwater level can be assumed at below the depth of ~10m from the existing ground surface, so the hydrostatic pressure can be ignored if the temporary wall is adequately drained. Additional earth pressures due to footings of adjacent structures will also have to be considered.

Loading on excavations in rock materials is largely controlled by kinematic failures, where defects in the rock mass allow blocks or wedges of material to slide into the excavation. The size and applied load by these failures is dependent on the orientation, spacing, persistence and characteristics of the defects surface. While this data is not typically gathered during conventional geotechnical investigations, Fortify Geotech has previously undertaken geological mapping of other deep excavations and road cuts in the Batemans Bay area , and the lateral earth pressures in the below sections are based on this data.

5.6.1 Lateral Pressure on Tied-Back Walls

Design horizontal earth/rock pressures to excavation floor level for soldier piers progressively tied back by tensioned ground anchors, and for walls restrained at the top by suspended floor slabs, can be calculated using a trapezoidal pressure distribution given by:

$$\sigma_h = \left(5H \times \frac{4z}{H}\right) + 0.4q \qquad \text{For } z < 0.25H$$

$$\sigma_h = (5H) + 0.4q \qquad \text{For } z > 0.25H$$

where,

σ_h	is the horizontal earth/rock pressure acting on the back of the wall, in kPa
H	is the total height of the full excavation to be supported, in metres
z	is the depth from the top of the excavation, in metres
q	is any uniformly distributed vertical surcharge acting on the ground surface at the top of the excavation, in kPa

The above expression takes no account of groundwater pressure, as it is assumed the temporary support walls will be fully drained. Where the walls are to be covered by shotcrete and/or where these will be incorporated into a permanent basement wall, synthetic drainage strips should be placed against the excavated face, leading to subsoil collector pipes at the base of the excavation, taken to a basement pump-out sump.

5.6.2 Lateral Pressure on Cantilevered Soldier Pile Walls

Design horizontal earth/rock pressures on soldier pile walls which derive their full support by cantilevering from the bedrock below the basement level, or for walls constructed in open excavation and backfilled later, can be calculated using a pressure distribution given by:

$$\sigma_h = 6d + 0.4q$$

where,

σ_h	is the horizontal earth/rock pressure acting on the back of the wall, in kPa
d	is the depth below the top of the excavation in contact with the soldier piers, in metres
q	is any uniformly distributed vertical surcharge acting on the ground surface at the top of the excavation, in kPa

The first term in the above expression is a triangular pressure distribution, the second a uniform distribution. Again, it is assumed that adequate drainage will be provided to prevent buildup of hydrostatic pressure behind the walls.

5.6.3 Passive Resistance

The horizontal passive resistance provided by socketed sections of soldier piers in weathered bedrock below excavation floor level can be calculated as:

$\sigma_p = 50z$ (Alluvial/Residual soil socket only)

$\sigma_p = 100z$ (XW &XW/HW bedrock socket only)

$\sigma_p = 250z$ (HW/MW & MW bedrock socket only)

where,

σ_p is the allowable passive pressure acting on the front of the pier/footing at depth z, in kPa

z is the pier socket length below excavation level in weathered bedrock, in metres

The effective width of a socketed pier for calculation of allowable passive resistance can be assumed to be equivalent to twice its actual width, except where the centre to centre distance between the piers is two diameters or less, in which case the soldier piers can be considered to act as one continuous wall.

If internal struts, propped against anchor blocks set in the basement floor are used, (which could be used as a preferred option for this site, as long grouted anchors would be required for a tied-back system), the passive resistance provided by the anchor blocks can be calculated using the same pressure distributions given above, although the effective width of the footing or block can be taken as 1.5 times its actual width. For calculating sliding resistance of concrete on the weathered bedrock, an ultimate base friction factor (tanδ) of 0.6 can be used, with an ultimate base adhesion (c) value of 50kPa.

5.6.4 Tie-Back Anchors

Recommended ultimate grout-to-soil and grout-to-bedrock bond values are as follows:

Stiff alluvial soils	60kPa
XW/HW & HW bedrock	225kPa
HW/MW & MW bedrock	600kPa

Some anchors should be proof-tested by pull-out tests to confirm the suitability of these allowable bond values, especially any anchor-holes that encounter groundwater.

It is recommended that ground anchors be inclined downward at between 5^o and 20^o, and that the “fixed” (anchored) section for calculation of pullout capacity be assumed to be the section of each anchor extending beyond the 45° line from the basement floor. Tensioned cable anchors should be used in preference to passive (non-tensioned) anchors.

5.7 PERMANENT BATTER STABILITY

Any permanent unsupported batters in soil and XW and XW/HW bedrock should be formed no steeper than 2(H):1(V), and at no steeper than 1(H):1(V) in HW and MW and less weathered bedrock. Permanent soil batters would need to be protected against erosion, either by grassing, stone pitching, shotcreting, dense landscape planting or other suitable means.

5.8 PERMANENT RETAINING WALLS

Retaining walls can be constructed to incorporate the excavation temporary support walls, or constructed separately, with the space backfilled later or braced by horizontal struts from the rock face to the temporary support wall.

The excavation floor level is expected to be above the permanent groundwater table, and therefore hydrostatic groundwater pressure need not be considered, although this should be confirmed during excavation.

Retaining walls that incorporate or are rigidly strutted to the excavation temporary supports should be designed to cater for the same lateral earth pressure distribution given in Section 5.6.1 for the tied-back walls.

Retaining walls constructed in open excavation and backfilled later should be designed on the basis of the lateral earth pressures given in Section 5.6.2 for cantilevered soldier pile walls.

Backfill behind walls constructed separate from the excavation support walls should be durable, clean, granular and free-draining. To prevent surface water entering the backfill, the upper 2m could consist of less pervious clayey soil fill.

5.9 CONTROLLED FILL CONSTRUCTION

For construction of any new fill foundation platforms and road subgrades, it is recommended that:

- Areas are fully stripped of all topsoil and uncontrolled fill material. A typical stripping depth of 0.1m/0.3m is expected (Table 4-2). Stripped foundations should be test rolled by a vibratory pad-foot roller of not less than 9 tonne static mass to check for any weak or wet areas that would require replacement. No fill should be placed until a geotechnical engineer has confirmed the suitability of the foundation.

- Controlled fill comprising suitable site excavated or imported materials of not greater than 75mm maximum particle size, be compacted in not greater than 150mm layers to a Density Ration not less than 95%ModMDD at about OMC.

- Fill placement and control testing be overviewed and certified by a geotechnical engineer at Level 1 involvement of AS3798 – 2007 “Guidelines on Earthworks for Commercial & Residential Developments”.

5.10 DESIGN CBR VALUES

The road subgrades are expected to comprise a mix of alluvial and soils, with variably weathered bedrock, or controlled fill of similar materials. Soil subgrades (natural and controlled fill) can be designed using an indicative subgrade CBR value of 3%, while an indicative subgrade CBR value of 8% can be used for weathered bedrock subgrades.

Any external carpark, access road, and ramp sections on natural soil subgrades can be designed using a CBR value of 5%, when compacted to 98%ModMDD. External carpark areas should be stripped of any existing fill and pavement gravels. All cut soil subgrades should be proof-rolled and inspected by a geotechnical engineer to confirm the CBR value, and to check for any weak subgrades requiring stabilisation or replacement.

5.11 GROUNDWATER CONTROL

The permanent groundwater table is expected to be at about at the depth of ~10m below the ground surface in the area where the deepest cuts will be located and is therefore expected to be well below any proposed excavation levels.

Temporary, perched seepages could occur at shallower depth following rainfall, within the more pervious soils or through joints in the bedrock. Such seepages are expected to be slow and should be controllable using a sump and pump in the basement floor.

Suitable surface drainage should be provided to ensure rainfall run-off or other surface water cannot pond against buildings or pavements. Suitable drainage must be provided behind retaining walls.

It may be prudent to allow for installation of subsoil drains along the upslope side(s) of pavements in areas of cut.

5.12 EARTHQUAKE SITE FACTOR

Table 2.3 of AS1170.4 “Minimum Design Loads on Structures - Part 4: Earthquake Loads” lists the earthquake acceleration coefficients for major centres to be considered in structural design. The Rosedale area has an acceleration coefficient of 0.08.

Section 4.2 of AS1170.4 “Minimum Design Loads on Structures – Part 4: Earthquake Loads” lists the site sub-soil classes to be considered in structural design. The site is classified as a “Class C_e – Shallow Soil Site”.

5.13 SLOPE INSTABILITY RISK ASSESSMENT

5.13.1 Method of Risk Assessment

The following sections of the report outline the slope instability risk assessment carried out for the site. The assessment is qualitative, based on the guidelines provided in the Australian Geomechanics Journal Vol 42 March 2007, and has been adopted by the NSW Department of Infrastructure, Planning and Natural Resources. This uses a matrix approach to determine the risk level of each hazard based on the likelihood and consequences of each hazard occurring.

Risk assessment involves the following components:

(i) Identification on the potential site slope hazards that may damage property and/or cause loss of life (Hazard Identification).

(ii) Estimation of the likelihood of each hazard occurring (Likelihood of Hazards Occurring).

(iii) Assessment of the potential consequences to property and people of these hazards occurring (Consequences of Hazards).

(iv) Evaluation of the significance of the assessed risks against criteria of acceptability (Significance of Risks).

Following the risk assessment, options for the treatment of the risk are provided as a guide to the owner, administrator and regulatory authorities who will need to decide whether to avoid or accept the risk, or to treat the site to reduce the likelihood and/or consequences of the hazards.

A flowchart, included in the Australian Geomechanics Journal, Vol 42, March 2007, paper on “Landslide Risk Management Concept & Guidelines” 2007 (Reference 3), which shows the processes of risk assessment/risk management is copied here in Appendix D provides guidelines for hillside construction.

5.13.2 Hazard Identification

The potential hazards (in the present condition, during construction, and post-construction) to slope stability at this site were considered, and include:

- Large Scale Transitional Slide
- Small Scale Slumps in the Soil Profile
- Failure of a Retaining Wall
- Surface Erosion
- Failure of Cut Batters (during and post-construction)
- Large Rockfall from Upslope

5.13.3 Likelihood of Hazards Occurring

5.14.3.1 Large Scale Translational Slide

The project is located in an area where has the potential of landslip and/or subsidence. To our knowledge, no landslips have been recorded in this immediate vicinity. Other landslides that have occurred in the area have generally been triggered by changes in the slope (cut or fill) or changes in the drainage, combined with heavy rainfall.

The combination of steep slopes dipping to the east and southeast at 20-25˚, and insufficient surface drainage increasing the possibility of landslip occurring. Some factors reducing the risk of a major landslide factors include a relatively shallow soil profile (1m/2m to weathered bedrock) with some mature trees remaining.

The existing trees on the slope are vertical, indicating no recent slope movement. For such a large-scale slide to happen there would need to be an extreme combination of unfavourable triggering conditions such as earthquakes, extreme rainfall, saturated soils, mass clearance of vegetation, unsupported excavations etc. The site is located in an area designated as having a Landslide Susceptibility rating of “Possible”. In accordance with the AGS ratings (Appendix D), such an event is considered to be “Unlikely”.

5.14.3.2 Small-Scale Slumps in the Soil Profile

Under adverse site conditions, such as when site soils are saturated, small slumping failures of the soils could conceivably occur. The ground surface is ‘lumpy’, indicating that slumps may have occurred in the past, so such an event is “Possible”.

5.14.3.3 Failure of Retaining Wall

The cuts to be constructed on the site will be supported by properly designed and constructed engineered retaining walls. As no failures or cracking was observed on similar retaining walls on the adjacent sites, the likelihood or a properly drained and constructed retaining wall failure is judged to be “Rare”.

5.14.3.4 Surface Erosion

There are some signs of soil creep and frost heaving on site that facilitate surface erosion by exposing soils and moved ‘rupturing’ grass-covered areas. In addition, the upper soils are quite silty/clay and surface water flow-paths are allowed to develop, therefore, surface erosion is “Likely”.

5.14.3.5 Failure of Cut Batter

Excavations to ~7m depth will be required for the development. The cuts will be either battered back to a stable angle or permanently supported by properly designed and constructed engineered retaining walls; however, temporary site cuts will be exposed during construction until the retaining walls can be constructed. The cuts will either be battered back to a stable angle, or a temporary excavation support system (shoring) will be implemented, and likelihood of a failure of a temporary site cut during construction is judged to be “Unlikely”.

5.14.3.6 Large Rockfall from Upslope

Large rockfalls from up the slope could have occurred in the past, as evidence by debris deposits on the lower slopes of the valley. However, given most of the boulders uphill of the site are currently partially covered with soils, this risk is reduced. Therefore, this event is “Unlikely”.

5.13.4 Consequences of Hazards Occurring

5.14.4.1 Large-Scale Translational Slide

Theoretically, a large-scale slide would occur with little or no warning, and the consequences to property and people would depend on the volume of the slide material, its velocity, and whether or not people are present, or in the downslope dwelling at the time. Using the AGS table of qualitative measures of vulnerability and consequences in Appendix D, we consider the consequences of such a rare event to be “Medium”, i.e Theoretically, there is the possibility of a fatality in the dwelling and/or the imposition of moderate damage to some of the structure in the event of this occurring.

5.14.4.2 Small-Scale Slumps in the Soil Profile

The consequence to the dwelling and associated structures of a small-scale slump and soil slides occurring in the soil after the new footings have been founded in bedrock is believed to be “Minor”. However, the slope uphill or downhill might be affected, and some material may slough onto the dwelling or downslope dwelling. The chance or temporal probability of persons being in the area during an earth slump is low, and therefore the risk of loss of life is low. The consequences for both property and persons are therefore rated as “Minor”.

5.14.4.3 Failure of a Retaining Wall

If a retaining wall failed, damage may well result to the dwelling, depending on many factors. In general, the consequences can be rated as “Minor to Medium”. The chance of persons being injured or of loss of life is low and the consequences to persons are therefore also rated as “Minor to Medium”.

5.14.4.4 Surface Erosion

If such an event develops and occurs, small cobbles/boulders may wash out of erosion gully slides and rolled downhill. The consequential damage to a structure would be “Insignificant”.

5.14.4.5 Failure of a Cut Batter

If a temporary site cut failed during construction, the chance of a construction worker being injured or of loss of life is moderate. The failure of a temporary site cut would typically result in a small-scale slump in the soil zone, which could injure a construction worker who is working in the vicinity. Therefore, the consequences to persons are rated as “Major”.

5.14.4.6 Large Rockfall from Upslope

The top of the escarpment is approximately >300m west of the site. Therefore, the consequences to people and property are considered as “Medium” to “Minor”.

5.13.5 Risk Estimation

A summary of estimated risk to property and life for each of the potential hazards identified in the previous sections is provided in Table 5-4. This risk assessment in Table 5-1 is based on the present conditions, prior to any mitigation measures being implemented. The resulting risk level was derived using the AGS risk analysis matrix presented in Appendix D.

Table 5-4: Risk Analysis Summary – Prior to Any Mitigation Measures Being Implemented

Potential Hazard	Assessed Likelihood	Assessed Consequences	Risk Level
Large-Scale Translational Slide	Unlikely	To Dwelling - Medium	Low
		To People in/adjacent to dwelling - Medium	Low
Small-Scale Slumps in Soil	Possible	To Dwelling - Minor	Medium
		To People in/adjacent to dwelling - Minor	Medium
Failure of Retaining Wall	Rare	To Dwelling – Medium to Minor	Low
		To People in/adjacent to dwelling - Medium to Minor	Low
Surface Erosion	Likely	To Dwelling - Insignificant	Low
		To People in/adjacent to dwelling - Insignificant	Low
Cut Batter	Unlikely	To Construction Workers - Major	Medium
Rockfalls	Unlikely	Medium to Minor	Low

5.13.6 Risk Treatment

To maintain and/or reduce the risk level of slope stability during the construction of the dwelling and associated structures and subsequent occupation, the following measures are recommended to be implemented:

- Ensure footings are founded into weathered bedrock.
- All temporary and permanent cut batters must be battered back to a stable angle and checked by a geotechnical engineer for a stability assessment.
- All retaining walls should be properly designed and constructed, and positively drained.
- Install and maintain adequate drainage of the site and ensure drains are free-flowing.
- The proposed development will cover most of the site, and the existing vegetation will be cleared/removed. Following completion of the development, any exposed ground must be protected against erosion by newly established vegetation or provide suitable erosion protection (e.g., erosion control mats, etc.).
- Periodic inspection of the slope uphill for signs of erosion developing and remediate as necessary.

Some useful guidelines on hillside construction, prepared by the Australian Geomechanics Society, are presented in Appendix D. A summary of estimated risk to property and life for each of the potential hazards identified in the previous sections is provided in Table 5-5. This risk assessment in Table 5-2 is based on the proposed future conditions, assuming that all recommended mitigation measures are implemented. The resulting risk level was derived using the AGS risk analysis matrix presented in Appendix D.

Table 5-5: Risk Analysis Summary – After Recommended Mitigation Measures Are Implemented

Potential Hazard	Assessed Likelihood	Assessed Consequences	Risk Level
Large-Scale Translational Slide	Unlikely	To Dwelling - Medium	Low
		To People in/adjacent to dwelling - Minor	Low
Small-Scale Slumps in Soil	Rare	To Dwelling - Minor	Very Low
		To People in/adjacent to dwelling - Insignificant	Low
Failure of Retaining Wall	Rare	To Dwelling – Minor to Medium	Low
		To People in/adjacent to dwelling - Minor	Very Low
Surface Erosion	Rare	To Dwelling - Insignificant	Very Low
		To People in/adjacent to dwelling - Insignificant	Low
Cut Batter	Unlikely	To construction workers - Minor	Low
Rockfalls	Unlikely	Minor/Insignificant	Very Low to Low

Note: This risk assessment in Table 5-2 is based on the assumed future conditions, assuming that all recommended mitigation measures are implemented.

5.13.7 Significance of Risks (Risk Evaluation)

Risk evaluation is the process by which owners, administrators and relevant regulatory authorities can decide whether the potential risks (See Table 5-4 and Table 5-5) are acceptable, and/or whether these can be feasibly eliminated or reduced by remedial treatment. Implications of each level of risk are described in Appendix D.

In the present conditions, the overall risk to property and people is assessed to be “Low” to “Medium” (See Table 5-4). Provided design and construction of the units is undertaken in accordance with accepted procedures for hillside construction, and treatments and mitigation measures are carried out to reduce the potential hazards (as recommended in Section 5.6 and Section 6), the risk is assessed to be “Very Low” to “Low” (See Table 5-5).

5.13.8 Suitability of the Proposed Development

Provided that the design and construction of the residential dwellings is undertaken in accordance with accepted procedures for hillside construction, and treatments and mitigation measures are carried out to reduce the potential hazards, the risk is assessed to be “Very Low” to “Low”. Therefore, it is assessed that the site is suitable for the proposed residential development (provided all the recommendations in our report are followed).

5.14 DETENTION BASIN LINING REQUIREMENTS

Based on the geotechnical profile of the site, the base of any detention basin in cut will expose to stiff/ medium dense Alluvial/ Residual clayey soil or weathered chert/siltstone bedrock. The exposed rock is typically extremely (XW) to highly weathered (HW) and the joints appear to be tight and relatively impervious. The laboratory permeability testing of the site soils obtained low to very low permeability results, which infers that the cut basin floors and sides also will be impervious. Considering this, clay liners do not appear be warranted for any detention basin formed in cut with a silty CLAY alluvial soil floor and sides. Where stormwater basins are formed using fill embankments of site-excavated material, it is recommended that the floors and sides are clay-lined. The clay liner must comprise excavated alluvial clay material, and be 300mm thick, compacted in 150mmthick layers to a Density Ratio of not less than 98%StdMDD. A geotechnical engineer must inspect the sides and bases of the ponds to confirm stability and to confirm the requirements for a liner.

5.15 HOLD POINTS FOR GEOTECHNICAL INSPECTIONS

The following should be used as a guideline for hold points that require geotechnical inspections:

- All Footing excavations prior to pouring concrete.
- All soldier pier/piles to confirm the soil profile and bearing in adequate material.
- All unsupported excavations deeper than 1.5m to ensure batter stability.
- All mobile crane and concrete pump foundations prior to mobile crane setting up on site.
- All scaffold and formwork foundations on soil.
- Vibration monitoring where rock hammering for the excavation is being conducted.
- All groundslab and pavement subgrade foundations.
- All road pavement subgrades
- All foundations prior to controlled fill placement.
- Supervision and certification of all controlled fill.

Fortify Geotech Pty Ltd

REFERENCES

Australia. Geological Survey of New South Wales, Maitland. (2013). Eurobodalla 1:10 000 coastal quaternary geology map series.

Standards Australia, “AS2870 - 1996 - Residential Slabs & Footings - Construction”.

Standards Australia, “AS3798 – 2007 - Guidelines on earthworks for commercial and residential developments”.

Standards Australia, “AS1170.4 - 1993 - Minimum Design Loads on Structures - Part 4: Earthquake Loads”.

FIGURE 1: SITE LOCALITY

C14934

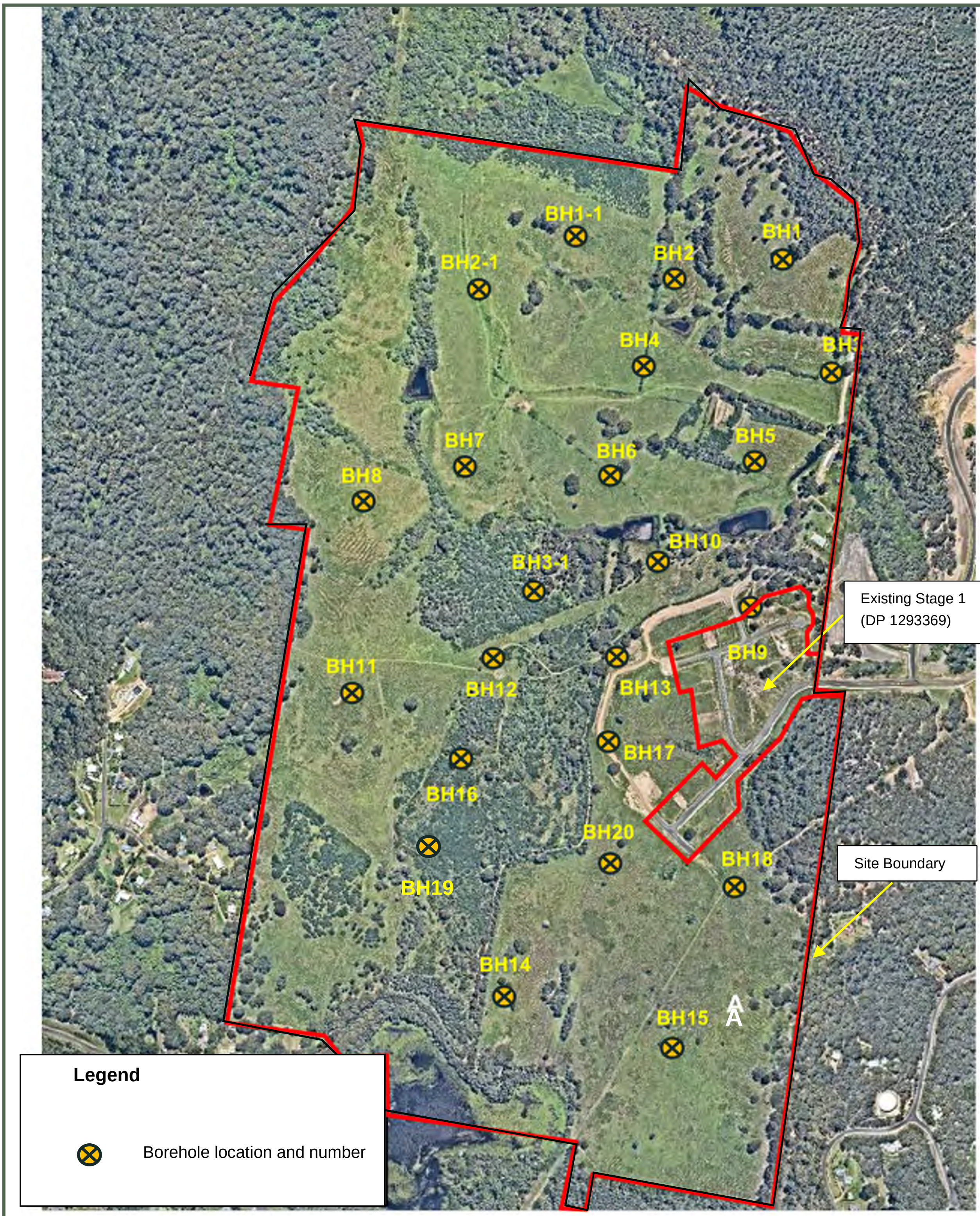


FIGURE 2: AERIAL PHOTOGRAPH AND BOREHOLE LOCATIONS	C14934

FIGURE 3: GEOLOGY MAP EXTRACT SHOWING SITE LOCATION

C14934

Appendix A

Borehole Logs and Photographs BH1 to BH20

Borehole Log

Borehole No. **BH1**
Sheet 1 of 1
Job No. C14934

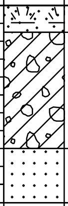
CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.15		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.8		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
				1.0 1.1			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
							BOREHOLE TERMINATED AT 1.1m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH10**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			0.2	1.0		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
			1.2			CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.			AUGER	
			1.6			SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			1.8								BEDROCK
			2	2.0			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				
							BOREHOLE TERMINATED AT 2m Refusal				
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
			8.0								

Logged By : EM Date : 1/16/24 Checked By : JM Date :

Borehole Log

Borehole No.	**BH11**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT: Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.15		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.5		CI	Gravelly sandy CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, fine to coarse sand, moist equal to plastic limit.				ALLUVIUM
				0.8		SC	Gravelly Clayey SAND; fine to coarse sand, pale brown, brown, low plasticity clay, fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				0.9			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK

BOREHOLE TERMINATED AT 0.9m
Refusal

1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

Logged By : EM   Date : 1/16/24   Checked By : JM   Date :

FORTIFY
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Borehole Log

Borehole No.	**BH1-1**
Sheet	1 of 2
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Hojin
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CL	Sandy Silty CLAY; low plasticity, dark brown, black, fine to coarse sand, with fine to coarse, sub-rounded to sub-angular gravel, moist less than plastic limit.				TOPSOIL
				0.2		CL	Gravelly sandy CLAY; low plasticity clay, brown, fine to coarse sand, fine to coarse, sub-angular to angular gravel, moist less than plastic limit.				ALLUVIAL
				0.6			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				1.0							
				1.8			CORING COMMENCED AT 1.8m				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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Cored Borehole Log

Borehole No.	**BH1-1**
	2 of 3
Job No.	C14934

CLIENT: Walker Corporation

PROJECT: Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type :
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth (m)	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range (VL L M H VH EH)	Is(50) MPa (D = diaxial A = axial)	Core Length (mm) (30 100 300 1000 3000)	Defects
				1.0							
			1.8			CORING COMMENCED AT 1.8m DEPTH					
NMLC CORING	30% 95%	None Encountered		2.0		CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.					
	15% 100%		2.8	3.0		CHERT; white, blue grey, with interlayers of siltstone and mudstone, highly weathered, medium strength, fine grained.			D = 20.0		
	52% 100%			4.0							
	30% 100%			5.0							
	40% 100%		5.8	6.0		Siltstone; fine grain, white, pale grey, interlayers of Chert, highly to moderately weathered, medium strength.			D = 16.0		
			7	7.0		BOREHOLE TERMINATED AT 7m Refusal					
				8.0							

Defect Description

Core Break joints, , 5°, irregular, rough, veneer, -
Open Joint joints, , 70°, irregular, rough, veneer, -
Open Joint joints, , 70°, irregular, rough, veneer, -
Open Joint joints, , 45°, irregular, rough, veneer, -
Fragmented, -
Open Joint joints, , 5°, stepped, very rough, veneer, -
Core Break joints, , 45°, stepped, very rough, veneer, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 30°, planar, rough, veneer, -
Open Joint joints, , 30°, planar, rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 30°, planar, rough, veneer, -
Open Joint joints, , 30°, planar, rough, veneer, -
Open Joint joints, , 60°, planar, rough, veneer, -
Fractured, -
Core Break joints, , 5°, irregular, very rough, clean, -
Open Joint joints, , 45°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 45°, irregular, very rough, veneer, -
Open Joint joints, , 45°, irregular, very rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 60°, irregular, very rough, veneer, -
Core Break joints, , 60°, stepped, rough, clean, -
Open Joint joints, , 60°, planar, rough, veneer, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 5°, irregular, very rough, veneer, -
Open Joint joints, , 60°, irregular, very rough, veneer, -
Open Joint joints, , 40°, irregular, rough, veneer, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 60°, planar, rough, clean, -
Open Joint joints, , 40°, planar, rough, clean, -
Open Joint joints, , 40°, planar, rough, veneer, -
Open Joint joints, , 40°, irregular, rough, veneer, -
Open Joint joints, , 5°, irregular, rough, veneer, -
Open Joint joints, , 5°, irregular, rough, veneer, -
Open Joint joints, , 70°, irregular, rough, veneer, -
Core Break joints, , 60°, stepped, rough, clean, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 45°, irregular, rough, veneer, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 45°, irregular, rough, veneer, -
Open Joint joints, , 60°, irregular, rough, veneer, -
Open Joint joints, , 60°, planar, rough, clean, -

Logged By : JH Date : 1/15/24 Checked By : JM Date :

FORTIFY
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Cored Borehole Log

Borehole No.	**BH1-1**
	3 of 3
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type :
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth (m)	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range VL L M H VH EH	Is(50) MPa (D = diaxial A = axial)	Core Length (mm) 30 100 300 1000 3000	Defects	Defect Description
												Open Joint joints, , 60°, planar, rough, clean, - Open Joint joints, , 60°, planar, rough, veneer, - Open Joint joints, , 60°, planar, rough, veneer, - Open Joint joints, , 60°, irregular, rough, veneer, -
				9.0								
				10.0								
				11.0								
				12.0								
				13.0								
				14.0								
				15.0								
				16.0								

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH12**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.2		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
						CI	Gravelly sandy CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, fine to coarse sand, moist equal to plastic limit.			AUGER	ALLUVIUM
			1	1.0 1.2			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				2.0 3.0 4.0 5.0 6.0 7.0 8.0			BOREHOLE TERMINATED AT 1.2m Refusal				

Logged By : EM Date : 1/16/24 Checked By : JM Date :

FORTIFY GEOTECH

Borehole Log

Borehole No. **BH13**

Sheet 1 of 1

Job No. C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.15		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
				0.85		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				1.5			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				1.7			BOREHOLE TERMINATED AT 1.7m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH14**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT: Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.2		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.4		CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				ALLUVIUM
				0.6			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				1.0			BOREHOLE TERMINATED AT 0.6m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH15**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING	0.2			CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			0.5			CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
			1.2	1.0		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			1.4				CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
							BOREHOLE TERMINATED AT 1.4m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
			8.0								

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH16**
Sheet	1 of 1
Job No.	C14934

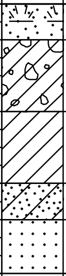
CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.



Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.2		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.6		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
			1	1.0		CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
				1.2		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				1.5			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				2.0			BOREHOLE TERMINATED AT 1.5m Refusal				
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No. **BH17**

Sheet 1 of 1

Job No. C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.1		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.4		SC	Sandy CLAY; low plasticity clay, brown, dark brown, fine to coarse sand, trace of fine to coarse, angular to sub-angular gravel, moist.				ALLUVIUM
				1.2		CL	Sandy silty CLAY; low plasticity clay, red brown, pale grey, lfine to coarse sand, trace of fine to coarse, angular to sub-angular gravel, moist.				
				2		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.			AUGER	RESIDUAL SOIL
				2.2			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK

BOREHOLE TERMINATED AT 2.2m
Refusal

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No. **BH18**

Sheet 1 of 1

Job No. C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.1		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.8		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.			AUGER	RESIDUAL SOIL
				1			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				1.0			BOREHOLE TERMINATED AT 1m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24

Checked By : JM Date :

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Borehole Log

Borehole No.	BH19
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered					CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.15		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
				1.0							
				1.5		CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
				2.0		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				2.5			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				3.0			BOREHOLE TERMINATED AT 3m Refusal				
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No. **BH2**

Sheet 1 of 1

Job No. C14934

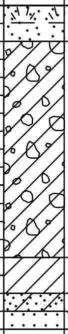
CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :



Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			0.2	1.0		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
			1.4			CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
			1.6			SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			1.7				CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
			1.8	2.0			BOREHOLE TERMINATED AT 1.8m Refusal				
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
			8.0								

Logged By : EM Date : 1/16/24 Checked By : JM Date :

Borehole Log

Borehole No.	**BH20**
Sheet	1 of 1
Job No.	C14934

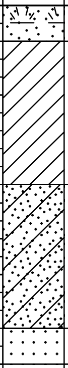
CLIENT: Walker Corporation

PROJECT: Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :



Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING			CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.2	CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				ALLUVIUM
				1 1.0	SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.			AUGER	RESIDUAL SOIL
				1.8		CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				2 2.0		BOREHOLE TERMINATED AT 2m Refusal				
				3.0						
				4.0						
				5.0						
				6.0						
				7.0						
				8.0						

Logged By : EM Date : 1/16/24 Checked By : JM Date :

BOREHOLE/EXCAVATION LOG C14934 GINT.GPJ EXC.GDT 2/22/24

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GEOTECH

Borehole Log

Borehole No.	**BH2-1**
Sheet	1 of 2
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Hojin
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.2		CL	Sandy Silty CLAY; low plasticity, dark brown, black, fine to coarse sand, with fine to coarse, sub-rounded to sub-angular gravel, moist less than plastic limit.				TOPSOIL
				0.7		CL	Sandy Gravelly CLAY; low plasticity, brown, fine to coarse sand, fine to coarse, sub-angular to angular gravel, moist less than plastic limit.				ALLUVIAL
				1		SC	Clayey SAND; fine to coarse sand, brown, orange brown, low plasticity clay, moist.				
				1.5			CHERT; blue grey, grey, white, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				2.2			Siltstone; fine grain, white, pale grey, interlayers of Chert, extremely to highly weathered, low to medium strength.				
				3.5			CHERT; dark grey, blue grey, white, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				
				4			CHERT; dark grey, blue grey, white, with interlayers of siltstone and mudstone, highly to moderately weathered, medium strength, fine grained.				
							CORING COMMENCED AT 4m				

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

Logged By : JH Date : 1/15/24 Checked By : JM Date :

asda

FORTIFY
GEOTECH

Cored Borehole Log

Borehole No. **BH2-1**

2 of 2

CLIENT: Walker Corporation	Job No. C14934
PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW 73 Bevian Road, Rosedale, NSW	Location : See report Collar Level : Not Known Angle From Horizontal : 90° Bearing : N.A.
Drill Type : Barrel Type, Length, Drilling fluid :	

Method/Casing	R.Q.D./Lift	Water	RL (m)	Depth (m)	Graphic Log	Soil or Rock Substance Description	Degree of Weathering	Estimated Strength Range (VL L M H VH EH)	Is(50) MPa (D = diaxial, A = axial)	Core Length (mm) (30 100 300 1000 3000)	Defects	Defect Description
				0.0 – 4.0		CORING COMMENCED AT 4m DEPTH						
NMLC CORING	67% 100%	None Encountered		4.0 – 5.0		CHERT; dark grey, blue grey, white, with interlayers of siltstone and mudstone, highly to moderately weathered, medium strength, fine grained.			D = 21.0			Open Joint joints, , 60°, planar, rough, veneer, - Open Joint joints, , 60°, planar, rough, veneer, - Fractured and fragmented, - Open Joint joints, , -°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Core Break joints, , 5°, stepped, very rough, clean, -
	65% 100%			5.0 – 6.0					D = 83.0			Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 70°, planar, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 5°, stepped, rough, veneer, - Open Joint joints, , 60°, stepped, rough, veneer, - Fractured and fragmented, -
	52% 100%			6.0 – 7.0								Core Break joints, , 5°, stepped, rough, clean, - Open Joint joints, , 80°, stepped, rough, veneer, - Open Joint joints, , 45°, planar, rough, veneer, - Fractured and fragmented, - Open Joint joints, , 45°, planar, rough, veneer, - Open Joint joints, , 45°, irregular, rough, veneer, - Open Joint joints, , 45°, irregular, rough, veneer, - Open Joint joints, , 45°, irregular, rough, veneer, - Open Joint joints, , 60°, irregular, rough, veneer, - Open Joint joints, , 45°, irregular, rough, veneer, - Open Joint joints, , 45°, irregular, very rough, veneer, - Open Joint joints, , 60°, irregular, rough, veneer, -
				7.0 – 8.0		BOREHOLE TERMINATED AT 7m Refusal						

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH3**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING	0.3		▨	CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			1.5	1.0	▨	CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.			AUGER	ALLUVIUM
			2	2.0	▨	CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
			2.5		▨	SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			3	3.0	▨		CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
			8.0	4.0 5.0 6.0 7.0			BOREHOLE TERMINATED AT 3m Refusal				

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH3-1**
Sheet	1 of 2
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report
Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Hojin
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.1		CL	Sandy Silty CLAY; low plasticity, dark brown, black, fine to coarse sand, with fine to coarse, sub-rounded to sub-angular gravel, moist less than plastic limit.				TOPSOIL
				0.6		CL	Sandy Gravelly CLAY; low plasticity, brown, fine to coarse sand, fine to coarse, sub-angular to angular gravel, moist less than plastic limit.				ALLUVIAL
				1 1.0			CHERT; blue grey, grey, white, with interlayers of siltstone and mudstone, extremely weathered to highly weathered, medium strength, fine grained. CORING COMMENCED AT 1m				BEDROCK
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : JH Date : 1/15/24 Checked By : JM Date :

FORTIFY
GEOTECH

Cored Borehole Log

Borehole No. **BH3-1**

2 of 2

CLIENT: Walker Corporation

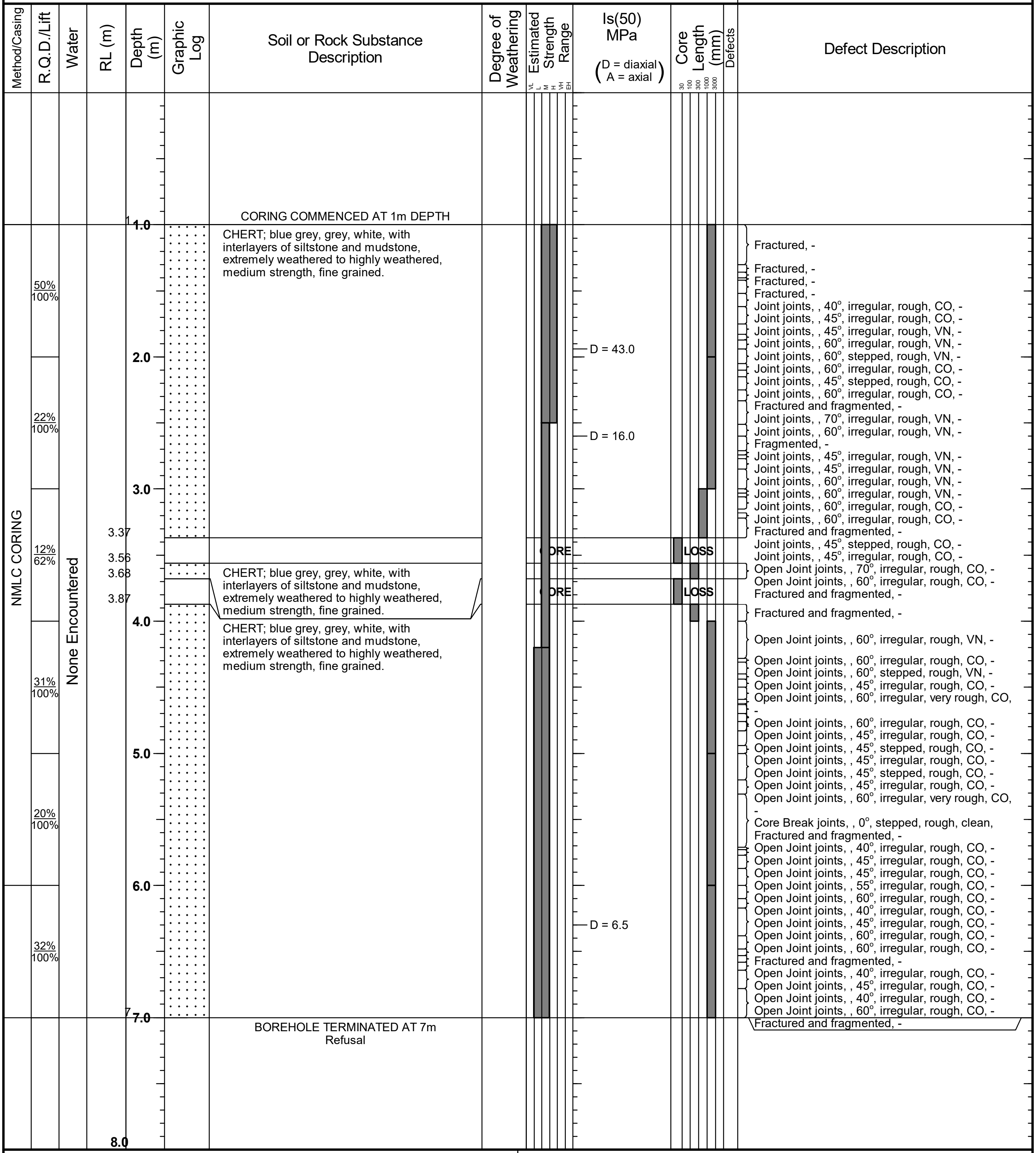
Job No. C14934

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type :
Barrel Type, Length, Drilling fluid :



Depth (m)	RL (m)	R.Q.D./Lift	Soil or Rock Substance Description	Is(50) MPa
1.0			CORING COMMENCED AT 1m DEPTH	
1.0 – 3.37	3.37	50% 100%	CHERT; blue grey, grey, white, with interlayers of siltstone and mudstone, extremely weathered to highly weathered, medium strength, fine grained.	D = 43.0
		22% 100%		D = 16.0
3.37 – 3.56	3.56	12% 62%	CORE LOSS	
3.56 – 3.68	3.68		CHERT; blue grey, grey, white, with interlayers of siltstone and mudstone, extremely weathered to highly weathered, medium strength, fine grained.	
3.68 – 3.87	3.87		CORE LOSS	
3.87 – 7.0		31% 100%	CHERT; blue grey, grey, white, with interlayers of siltstone and mudstone, extremely weathered to highly weathered, medium strength, fine grained.	
		20% 100%		
		32% 100%		D = 6.5
7.0			BOREHOLE TERMINATED AT 7m Refusal	

Defect Description

Fractured, -
Fractured, -
Fractured, -
Fractured, -
Joint joints, , 40°, irregular, rough, CO, -
Joint joints, , 45°, irregular, rough, CO, -
Joint joints, , 45°, irregular, rough, VN, -
Joint joints, , 60°, irregular, rough, VN, -
Joint joints, , 60°, stepped, rough, VN, -
Joint joints, , 60°, irregular, rough, CO, -
Joint joints, , 45°, stepped, rough, CO, -
Joint joints, , 60°, irregular, rough, CO, -
Fractured and fragmented, -
Joint joints, , 70°, irregular, rough, VN, -
Joint joints, , 60°, irregular, rough, VN, -
Fragmented, -
Joint joints, , 45°, irregular, rough, VN, -
Joint joints, , 45°, irregular, rough, VN, -
Joint joints, , 60°, irregular, rough, VN, -
Joint joints, , 60°, irregular, rough, VN, -
Joint joints, , 60°, irregular, rough, CO, -
Joint joints, , 60°, irregular, rough, CO, -
Fractured and fragmented, -
Joint joints, , 45°, stepped, rough, CO, -
Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 70°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Fractured and fragmented, -
Fractured and fragmented, -
Open Joint joints, , 60°, irregular, rough, VN, -
Open Joint joints, , 60°, irregular, rough, CO, -
Open Joint joints, , 60°, stepped, rough, VN, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, very rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 45°, stepped, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 45°, stepped, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, very rough, CO, -
Core Break joints, , 0°, stepped, rough, clean,
Fractured and fragmented, -
Open Joint joints, , 40°, irregular, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 55°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Open Joint joints, , 40°, irregular, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Fractured and fragmented, -
Open Joint joints, , 40°, irregular, rough, CO, -
Open Joint joints, , 45°, irregular, rough, CO, -
Open Joint joints, , 40°, irregular, rough, CO, -
Open Joint joints, , 60°, irregular, rough, CO, -
Fractured and fragmented, -

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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Borehole Log

Borehole No.	BH4
Sheet	1 of 1
Job No.	C14934

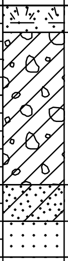
CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.



Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING				CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.15		CI	Gravelly sandy CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, fine to coarse sand, moist equal to plastic limit.				ALLUVIUM
				1 1.0		SC	Gravelly clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				1.2 1.4			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained. BOREHOLE TERMINATED AT 1.4m Refusal				BEDROCK

Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

Logged By : EM   Date : 1/16/24   Checked By : JM   Date :

BOREHOLE/EXCAVATION LOG C14934 GINT.GPJ EXC.GDT 2/22/24

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Borehole Log

Borehole No.	**BH4-1**
Sheet	1 of 2
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Hojin
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.1		CL	Sandy Silty CLAY; low plasticity, dark brown, black, fine to coarse sand, with fine to coarse, sub-rounded to sub-angular gravel, moist less than plastic limit.				TOPSOIL
				0.5		CL	Sandy Gravelly CLAY; low plasticity, dark brown, fine to coarse sand, fine to coarse, sub-angular to angular gravel, moist less than plastic limit.				ALLUVIAL
				0.7		CL	Sandy CLAY; low plasticity, brown, fine to coarse sand, trace of fine to coarse, sub-angular to angular gravel, moist less than plastic limit.				
				0.9		SC	Clayey SAND; fine to coarse sand, brown, orange brown, low plasticity clay, moist.				
				1.0 2		SW-SC	Clayey gravelly SAND; fine to coarse sand, brown, orange brown, low plasticity clay, fine to coarse, angular to sub-angular gravel (extremely to highly weathered sandstone fragments), moist.				RESIDUAL SOIL
				2.0 2.6			Siltstone/Sandstone; fine grain, blue grey, grey, interlayers of Chert, extremely to highly weathered, low strength.				BEDROCK
				3.0 4.0 5.0 6.0 7.0 8.0			CORING COMMENCED AT 2.6m				

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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FORTIFY GEOTECH

Cored Borehole Log

Borehole No. **BH4-1**

2 of 2

CLIENT: Walker Corporation

Job No. C14934

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Horizontal : 90°
Bearing : N.A.

Drill Type :
Barrel Type, Length, Drilling fluid :

Method/Casing	R.Q.D./Lift	Water	Depth (m)	Soil or Rock Substance Description	Is(50) MPa (D = diaxial A = axial)
				CORING COMMENCED AT 2.6m DEPTH	
NMLC CORING	57% 100%	None Encountered	2.6	Siltstone/Sandstone; fine grain, blue grey, grey, interlayers of Chert, extremely to highly weathered, low strength.	
	42% 100%		3.5	CHERT; dark grey, grey, white, with interlayers of siltstone and mudstone, highly weathered, low to medium strength, fine grained.	D = 16.7 D = 19.5
			4.1	Siltstone; fine grain, white, pale grey, interlayers of Chert, highly weathered, low to medium strength.	
	52% 100%		4.85	Sandstone; fine grain, grey, brown, highly to moderately weathered, medium strength.	D = 11.2
	66% 100%		5.6	Siltstone; fine grain, white, pale grey, interlayers of Chert, highly weathered, medium strength.	
	0% 100%		6.4	Siltstone; fine grain, white, pale grey, moderately weathered, medium strength.	
			7	BOREHOLE TERMINATED AT 7m Refusal	

Defect Description

Open Joint joints, , 5°, planar, rough, stained, -
Fractured and fragmented, -
Open Joint joints, , 10°, planar, very rough, veneer, -
Open Joint joints, , 10°, irregular, rough, veneer, -
Open Joint joints, , 5°, irregular, rough, veneer, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, veneer, -
Core Break joints, , 40°, irregular, very rough, clean, -
Open Joint joints, , 60°, planar, rough, veneer, -
Open Joint joints, , 60°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 40°, irregular, very rough, veneer, -
Open Joint joints, , 40°, planar, rough, veneer, -
Open Joint joints, , 60°, planar, rough, veneer, -
Open Joint joints, , 70°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, veneer, -
Core Break joints, , 5°, stepped, very rough, clean, -
Open Joint joints, , 60°, planar, rough, veneer, -
Open Joint joints, , 60°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, stained, -
Open Joint joints, , 45°, planar, rough, veneer, -
Fractured and fragmented, -
Open Joint joints, , 45°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, stained, -
Open Joint joints, , 60°, planar, rough, stained, -
Open Joint joints, , 60°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, veneer, -
Open Joint joints, , 5°, planar, rough, veneer, -
Core Break joints, , 5°, stepped, very rough, clean, -
Open Joint joints, , 45°, planar, rough, veneer, -
Open Joint joints, , 45°, planar, rough, stained, -
Open Joint joints, , 60°, irregular, very rough, veneer, -
Open Joint joints, , 60°, irregular, very rough, veneer, -
Open Joint joints, , 45°, irregular, very rough, veneer, -
Open Joint joints, , 5°, planar, rough, stained, -
Open Joint joints, , 5°, planar, rough, veneer, -
Fractured and fragmented, -

Logged By : JH Date : 1/15/24 Checked By : JM Date :

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Borehole Log

Borehole No. **BH5**
Sheet 1 of 1
Job No. C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING	0.2			CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			1.5	1.0		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.			AUGER	ALLUVIUM
			1.8			CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
			2.5	2.0		CL	Sandy silty CLAY; low plasticity clay, red brown, pale grey, lfine to coarse sand, trace of fine to coarse, angular to sub-angular gravel, moist.				
			3.5	3.0		SC	Gravelly clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			3.8				CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				4.0 5.0 6.0 7.0			BOREHOLE TERMINATED AT 3.8m Refusal				
			8.0								

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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FORTIFY GEOTECH

Borehole Log

Borehole No.	**BH6**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING	0.2			CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			1.2	1.0		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
			1.6			CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
			1.8			SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
			2	2.0			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
							BOREHOLE TERMINATED AT 2m Refusal				
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
			8.0								

Logged By : EM Date : 1/16/24 Checked By : JM Date :

Borehole Log

Borehole No.	BH7
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT: Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Equipment Type : Excavator
Hole Diameter :

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.2		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			1	1.0		CI	Gravelly CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.				ALLUVIUM
				1.4		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.				RESIDUAL SOIL
				1.8			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
				2.0			BOREHOLE TERMINATED AT 1.8m Refusal				
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

BOREHOLE/EXCAVATION LOG C14934 GINT.GPJ EXC.GDT 2/22/24

Logged By : EM Date : 1/16/24 Checked By : JM Date :

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Borehole Log

Borehole No.	**BH8**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING	0.2			CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
			0.8			CI	Sandy CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse sand, moist equal to plastic limit.				ALLUVIUM
			1.3	1.0		CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
			2.2	2.0		SC	Silty clayey SAND; fine to coarse, red brown, pale grey, low plasticity clay, trace of fine to coarse, angular to sub-angular gravel, moist.			AUGER	RESIDUAL SOIL
			2.4				CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK

BOREHOLE TERMINATED AT 2.4m
Refusal

Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

Logged By : EM Date : 1/16/24 Checked By : JM Date :

FORTIFY
GEOTECH

Borehole Log

Borehole No.	**BH9**
Sheet	1 of 1
Job No.	C14934

CLIENT: Walker Corporation

PROJECT Proposed Residential Subdivision - 73 Bevian Road, Rosedale, NSW
73 Bevian Road, Rosedale, NSW

Location : See report

Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

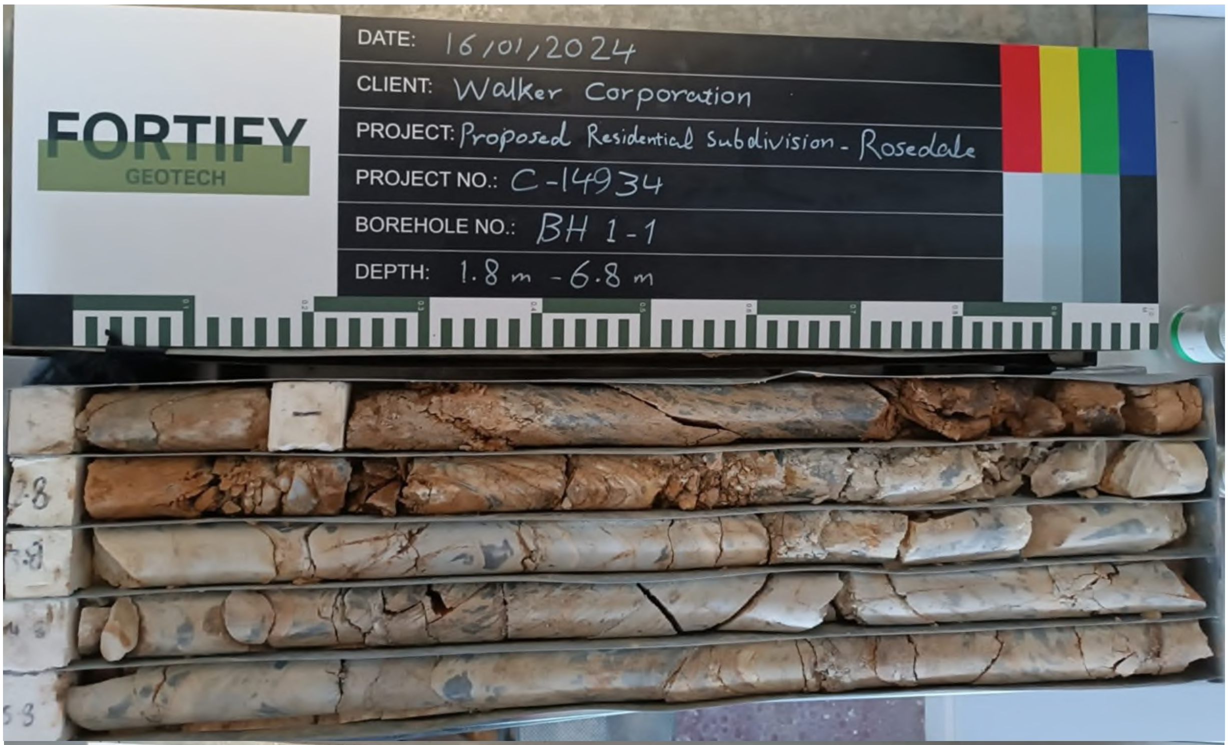
Equipment Type : Excavator
Hole Diameter :

Sample No.	Water	Method/ Casing	RL (m)	Depth (m)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Moisture Condition	Consistency or Relative Density	Field Test Results	Geological Profile
	None Encountered	AUGERING		0.15		CI	Silty CLAY; low plasticity clay, dark brown, trace of root fibres, moist equal to plastic limit.				TOPSOIL
				0.6		CI	Sandy CLAY; low plasticity clay, brown, red brown, red mottled, fine to coarse sand, trace of fine to coarse, angular to sub-angular gravel, moist equal to plastic limit.			AUGER	ALLUVIUM
				1.0 1.2		CL	Silty CLAY; low plasticity clay, pale brown, pale grey, moist equal to plastic limit.				
				1.5			CHERT; blue grey, grey, with interlayers of siltstone and mudstone, extremely to highly weathered, low to medium strength, fine grained.				BEDROCK
							BOREHOLE TERMINATED AT 1.5m Refusal				
				2.0							
				3.0							
				4.0							
				5.0							
				6.0							
				7.0							
				8.0							

Logged By : EM Date : 1/16/24 Checked By : JM Date :

BOREHOLE/EXCAVATION LOG C14934 GINT.GPJ EXC.GDT 2/22/24

asda



FORTIFY GEOTECH

DATE: 16/01/2024

CLIENT: Walker Corporation

PROJECT: Proposed Residential subdivision - Rosedale

PROJECT NO.: C-14934

BOREHOLE NO.: BH 1-1

DEPTH: 1.8 m - 6.8 m

FORTIFY GEOTECH

DATE: 16/01/2024

CLIENT: Walker Corporation

PROJECT: Proposed Residential subdivision - Rosedale

PROJECT NO.: C-14934

BOREHOLE NO.: BH 2-1

DEPTH: 4.0 - 7.0 m

CORE PHOTOGRAPHS

C14934

Appendix B

Laboratory Test Results

Material Test Report

J & A Geotech Testing Pty Ltd
Canberra Laboratory
Unit 2, 25 Dacre Street Mitchell ACT 2911
Phone: (02) 6255 5363
Email: justin.smith@jageotech.com.au

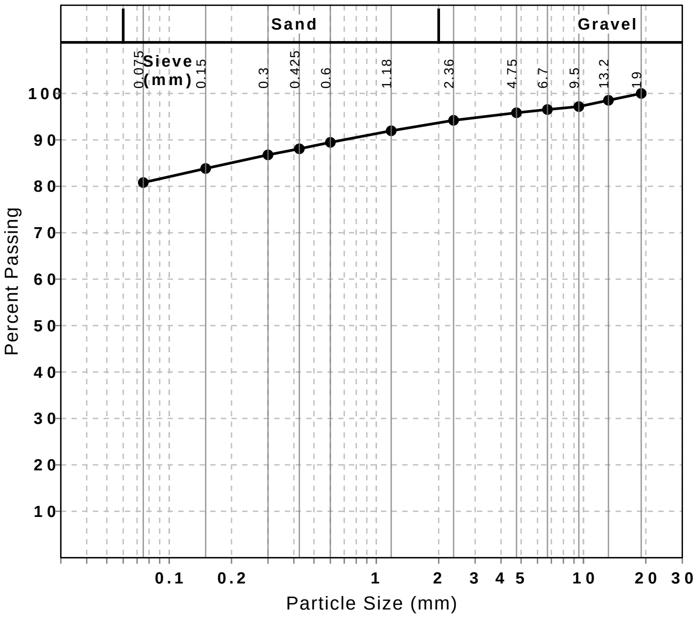
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

Report Number:	**CP241787-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*A*
Date Issued:	06/02/2024
Client:	ACT Geotechnical Engineers Pty Ltd Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact:	Jeremy Murray
Project Number:	CP241787
Project Name:	Proposed Residential Subdivision
Project Location:	73 Bevian Road Rosedale NSW
Client Reference:	C14934
Work Request:	9755
Sample Number:	CS9755A
Date Sampled:	25/01/2024
Dates Tested:	25/01/2024 - 05/02/2024
Sampling Method:	Sampled by Client *The results apply to the sample as received*
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH3, Depth: 1.2m - 2.0m**

Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
19 mm	**100**			0		
13.2 mm	**99**			1		
9.5 mm	**97**			1		
6.7 mm	**97**			1		
4.75 mm	**96**			1		
2.36 mm	**94**			2		
1.18 mm	**92**			2		
0.6 mm	**89**			2		
0.425 mm	**88**			1		
0.3 mm	**87**			1		
0.15 mm	**84**			3		
0.075 mm	**81**			3		

Particle Size Distribution



Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.62		
Optimum Moisture Content (%)	22.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual		
Curing Hours (h)	165.0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	23.1

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	48		
Plastic Limit (%)	22		
Plasticity Index (%)	**26**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.0**		
Cracking Crumbling Curling	Cracking		

Material Test Report

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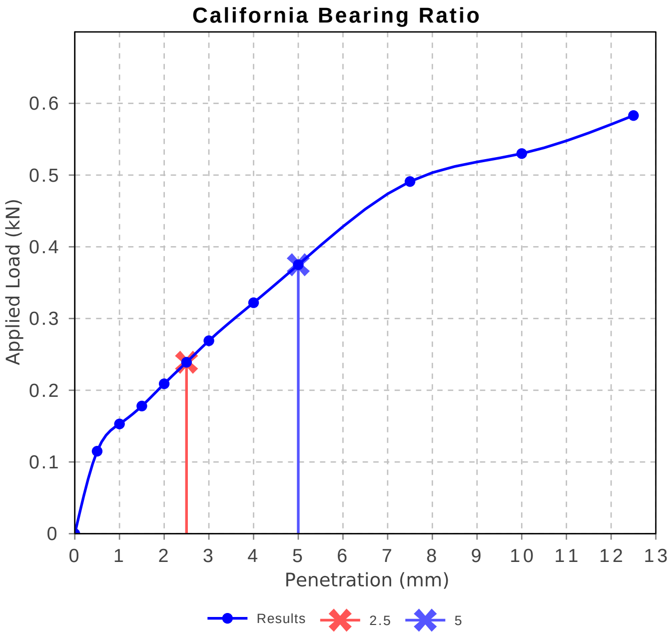
Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755B
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 05/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH5, Depth: 1.0m - 1.5m**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.71		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	98.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.66		
Field Moisture Content (%)	21.5		
Moisture Content at Placement (%)	18.5		
Moisture Content Top 30mm (%)	28.9		
Moisture Content Rest of Sample (%)	23.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	50.2		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

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Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755C
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 05/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH8, Depth: 1.5m - 2.0m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description			
Nature of Water	Distilled Water		
Temperature of Water (^{o}C)	25		

Material Test Report

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755D
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 05/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH9, Depth: 0.2m - 0.6m**

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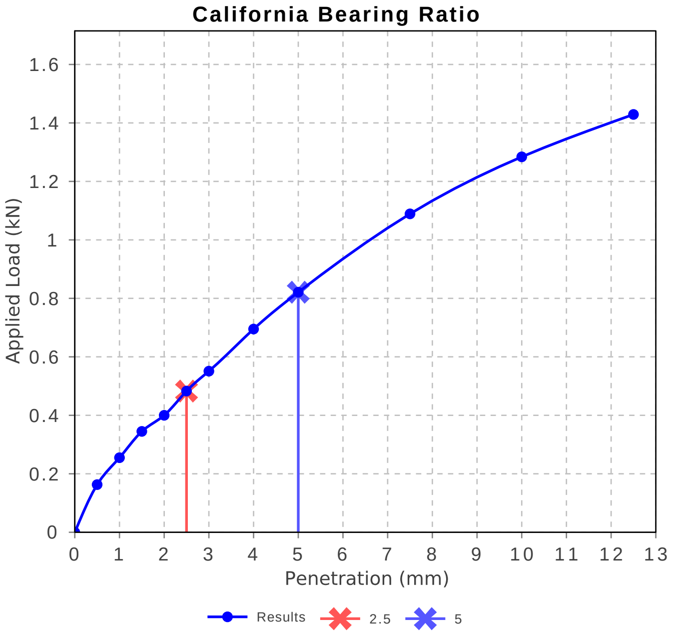
Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.77		
Field Moisture Content (%)	14.0		
Moisture Content at Placement (%)	15.5		
Moisture Content Top 30mm (%)	23.3		
Moisture Content Rest of Sample (%)	18.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	50.4		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

J & A Geotech Testing Pty Ltd

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Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

Report Number:	**CP241787-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*A*
Date Issued:	06/02/2024
Client:	ACT Geotechnical Engineers Pty Ltd Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact:	Jeremy Murray
Project Number:	CP241787
Project Name:	Proposed Residential Subdivision
Project Location:	73 Bevian Road Rosedale NSW
Client Reference:	C14934
Work Request:	9755
Sample Number:	CS9755E
Date Sampled:	25/01/2024
Dates Tested:	25/01/2024 - 01/02/2024
Sampling Method:	Sampled by Client *The results apply to the sample as received*
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH10, Depth: 1.2m - 1.6m**

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.58		
Optimum Moisture Content (%)	25.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual		
Curing Hours (h)	165.3		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	27.3

Material Test Report

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755F
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 05/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH12, Depth: 0.5m - 1.0m**

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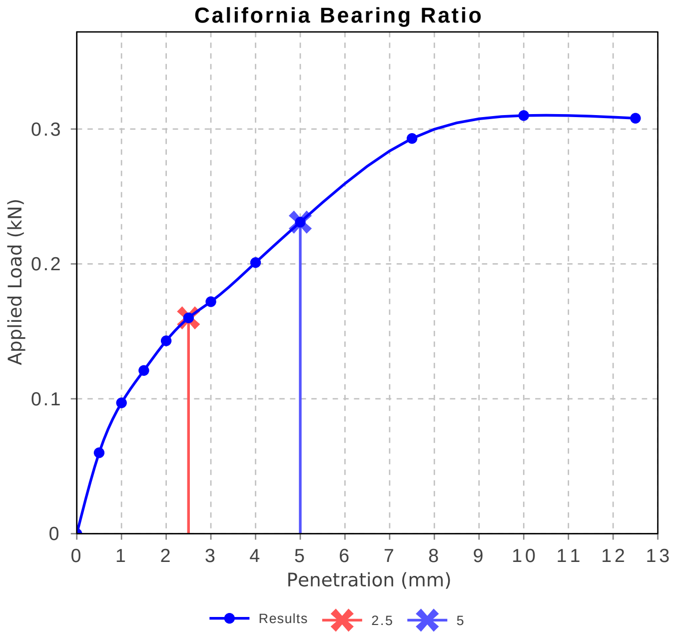
Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**1.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.65		
Optimum Moisture Content (%)	20.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.57		
Field Moisture Content (%)	20.6		
Moisture Content at Placement (%)	20.5		
Moisture Content Top 30mm (%)	35.5		
Moisture Content Rest of Sample (%)	27.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	50.5		
Swell (%)	3.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

J & A Geotech Testing Pty Ltd
Canberra Laboratory
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WORLD RECOGNISED ACCREDITATION
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Approved Signatory: Justin Smith
Managing Director
NATA Accredited Laboratory Number: 19979

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755G
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 05/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH17, Depth: 1.2m - 2.0m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description			
Nature of Water	Distilled Water		
Temperature of Water (^{o}C)	25		

Material Test Report

Report Number: **CP241787-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *A*
Date Issued: 06/02/2024
Client: ACT Geotechnical Engineers Pty Ltd
Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact: Jeremy Murray
Project Number: CP241787
Project Name: Proposed Residential Subdivision
Project Location: 73 Bevian Road Rosedale NSW
Client Reference: C14934
Work Request: 9755
Sample Number: CS9755H
Date Sampled: 25/01/2024
Dates Tested: 25/01/2024 - 07/02/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **BH18, Depth: 0.2m - 0.8m**

J & A Geotech Testing Pty Ltd
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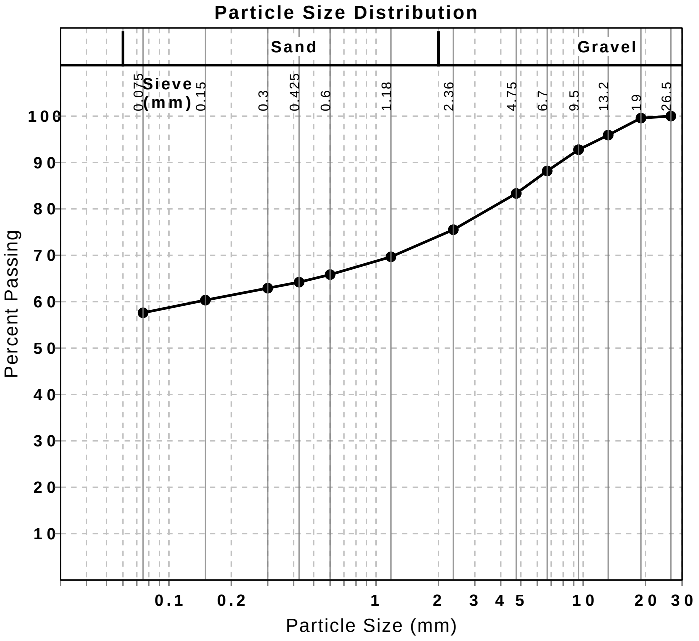
Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
26.5 mm	**100**			0		
19 mm	**100**			0		
13.2 mm	**96**			4		
9.5 mm	**93**			3		
6.7 mm	**88**			5		
4.75 mm	**83**			5		
2.36 mm	**76**			8		
1.18 mm	**70**			6		
0.6 mm	**66**			4		
0.425 mm	**64**			2		
0.3 mm	**63**			1		
0.15 mm	**60**			3		
0.075 mm	**58**			3		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	37		
Plastic Limit (%)	22		
Plasticity Index (%)	**15**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**7.0**		
Cracking Crumbling Curling	Cracking		



Material Test Report

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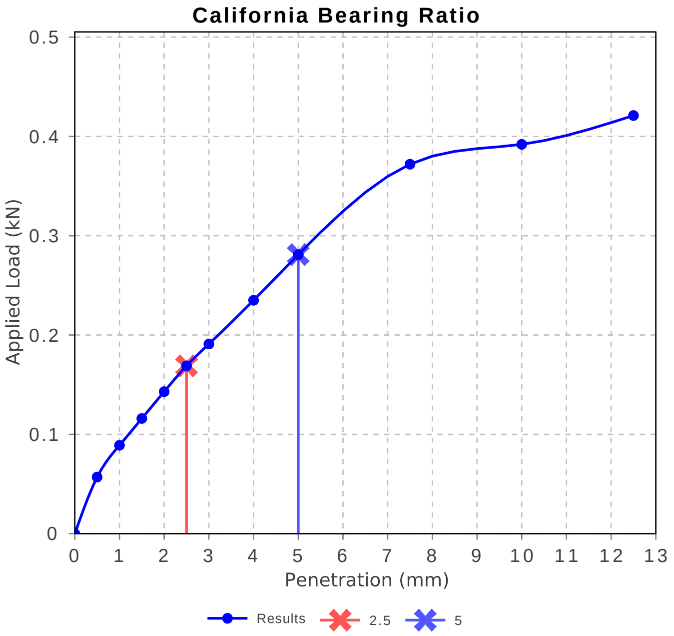
Report Number:	**CP241787-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*A*
Date Issued:	06/02/2024
Client:	ACT Geotechnical Engineers Pty Ltd Unit 2/157 Newcastle Street, Fyshwick ACT 2609
Contact:	Jeremy Murray
Project Number:	CP241787
Project Name:	Proposed Residential Subdivision
Project Location:	73 Bevian Road Rosedale NSW
Client Reference:	C14934
Work Request:	9755
Sample Number:	CS9755I
Date Sampled:	25/01/2024
Dates Tested:	25/01/2024 - 05/02/2024
Sampling Method:	Sampled by Client *The results apply to the sample as received*
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection:	Selected by Client
Sample Location:	**BH20, Depth: 1.0m - 1.8m**

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.83		
Optimum Moisture Content (%)	14.0		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.73		
Field Moisture Content (%)	14.5		
Moisture Content at Placement (%)	13.8		
Moisture Content Top 30mm (%)	36.8		
Moisture Content Rest of Sample (%)	20.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	50.6		
Swell (%)	3.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 342466

Client Details

Client	ACT Geotechnical Engineers Pty Ltd
Attention	Ehsan Mokhtari
Address	PO Box 9225, DEAKIN, ACT, 2600

Sample Details

Your Reference	**Proposed Residential Subdivison - 73 Bevian Rd**
Number of Samples	4 Soil
Date samples received	29/01/2024
Date completed instructions received	29/01/2024

Analysis Details

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

Samples were analysed as received from the client. 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	05/02/2024
Date of Issue	05/02/2024

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Chromium Suite					
Our Reference		342466-1	342466-2	342466-3	342466-4
Your Reference	UNITS	BH3	BH8	BH12	BH20
Depth		1.2-2.0	1.5-2.0	0.5-1.0	1.0-1.8
Date Sampled		17/01/2024	17/01/2024	17/01/2024	17/01/2024
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	29/01/2024	29/01/2024	29/01/2024	29/01/2024
Date analysed	-	30/01/2024	30/01/2024	30/01/2024	30/01/2024
pH $_{kcl}$	pH units	3.8	4.1	3.5	4.1
s-TAA pH 6.5	%w/w S	0.06	0.02	0.08	0.04
TAA pH 6.5	moles H^+ /t	36	14	49	23
Chromium Reducible Sulfur	%w/w	0.007	0.008	<0.005	0.08
a-Chromium Reducible Sulfur	moles H^+ /t	4	5	<3	51
S_{HCl}	%w/w S	0.025	0.012	0.032	0.027
S_{KCl}	%w/w S	0.010	0.005	0.011	0.014
S_{NAS}	%w/w S	0.029	0.015	0.042	0.025
ANC_{BT}	% $CaCO_3$	[NT]	[NT]	[NT]	[NT]
s-ANC_{BT}	%w/w S	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.094	0.045	0.12	0.14
a-Net Acidity	moles H^+ /t	54	26	70	86
Liming rate	kg $CaCO_3$ /t	4	2	5	6
a-Net Acidity without ANCE	moles H^+ /t	54	26	70	86
Liming rate without ANCE	kg $CaCO_3$ /t	4.0	2.0	5.2	6.4
s-Net Acidity without ANCE	%w/w S	0.086	0.042	0.11	0.14

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Net acidity including ANC has a safety factor of 1.5 applied. Neutralising value (NV) of 100% is assumed for liming rate. The recommendation that the SHCL concentration be multiplied by a factor of 2 to ensure retained acidity is not underestimated, has not been applied in the SHCL result. However, it has been applied in the SNAS calculation: SNAS % = (SHCL-SKCL)x2

QUALITY CONTROL: Chromium Suite					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			29/01/2024	1	29/01/2024	29/01/2024		29/01/2024	[NT]
Date analysed	-			30/01/2024	1	30/01/2024	30/01/2024		30/01/2024	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	1	3.8	3.7	3	97	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	1	0.06	0.06	0	[NT]	[NT]
TAA pH 6.5	moles H^+/t	5	Inorg-068	<5	1	36	36	0	97	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	1	0.007	0.007	0	104	[NT]
a-Chromium Reducible Sulfur	moles H^+/t	3	Inorg-068	<3	1	4	4	0	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	1	0.025	0.025	0	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	1	0.010	0.011	10	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	1	0.029	0.028	4	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	1	[NT]	[NT]		100	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	1	[NT]	[NT]		[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	1	0.094	0.094	0	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	Inorg-068	<5	1	54	54	0	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	1	4	4	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-068	<5	1	54	54	0	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	1	4.0	4.1	2	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	1	0.086	0.087	1	[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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

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.

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.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

FOR DIAMETRAL

Borehole	Depth (m)	Equivalent Diameter (cm)	Gauge Reading (kN)	(Is)-uncorrected	(Is)50	UCS (Mpa)	Strength Rating	Failure Type
BH1-1	***3.0 - 3.11***	*5.1*	*2.2*	**0.846**	**0.854**	**20.496**	*Medium*	Through Fabric
BH1-1	***6.6 - 6.7***	*5.1*	*1.8*	**0.692**	**0.698**	**16.752**	*Medium*	Through Fabric
BH2-1	***4.75 - 4.85***	*5.1*	*2.3*	**0.884**	**0.892**	**21.408**	*Medium*	Through Fabric
BH2-1	***5.45 - 5.56***	*5.1*	*9*	**3.46**	**3.491**	**83.784**	*Very High*	Through Fabric
BH3-1	***1.94 - 1.74***	*5.1*	*4.7*	**1.807**	**1.823**	**43.752**	*High*	Through Fabric
BH3-1	***2.6- -2.72***	*5.1*	*1.7*	**0.654**	**0.66**	**15.84**	*Medium*	Through Fabric
BH3-1	***6.3 - 6.4***	*5.1*	*0.7*	**0.269**	**0.271**	**6.504**	*Low*	Through Fabric
BH4-1	***3.45 - 3.55***	*5.1*	*1.8*	**0.692**	**0.698**	**16.752**	*Medium*	Through Fabric
BH4-1	***4.0 - 4.09***	*5.1*	*2.1*	**0.807**	**0.814**	**19.536**	*Medium*	Through Fabric
BH4-1	***5.1 - 5.22***	*5.1*	*1.2*	**0.461**	**0.465**	**11.16**	*Medium*	Through Fabric

Material Test Report

Alliance Specialised Testing

Date Issued: 13/03/2024
Report Number: P244030-1
Issue Number: 1
Reissue Reason: N/A

Client: J & A Geotech Testing Pty Ltd
Client Address: Unit 2/25 Dacre Street, Mitchell ACT 2911
Client Contact: Justin Smith <justin.smith@jageotech.com.au>
Client Project Number: 241787/9755

Project Number: P244030
Project Name: Proposed Residential Development - Rosedale
Project Location: 7 Bevian Road, Rosedale

Page	Test Date	Sample Number	Borehole	Depth	Test
2	2/03/2024	24-32320A	BH 3	1.2-2.0m	Triaxial Permeability - AS1289.6.7.3
3	1/03/2024	24-32320B	BH 10	1.2-1.6m	Triaxial Permeability - AS1289.6.7.3

Work Request: 32320
Date Sampled: 25/01/2024
Sampling Method: Sampled by Client - *The results apply to the sample received*

Specification: -

Approved Signature:
Specialised Testing Manager

Ian Goldschmidt

Accredited for compliance with ISO/IEC 17025 - Testing
NATA Accredited Laboratory Number: 15100

NATA
WORLD RECOGNISED ACCREDITATION

Specialised Testing - 1800 288 188

Determination of Permeability of a Soil Constant Head Method using a Flexible Wall Permeameter

Test Method: AS1289.6.7.3

Report Number: P244030-1
Sample Number: 24-32320A
Sample Source: BH 3, Depth: 1.2-2.0m

Sample Date: 25/01/2024
Test Date: 2/03/2024
Report Date: 13/03/2024

Project Name: Proposed Residential Development - Rosedale
Client: J & A Geotech Testing Pty Ltd
Sampling Method: Sampled by Client - The results apply to the sample received
Sample Description: CLAY; brown, trace sand, trace gravel
Specimen State: Disturbed
Permeant Used: Sydney tap water

Test Details	*Unit*	*Value*
Standard Maximum Dry Density	t/m^3	1.62
Initial Dry Density	t/m^3	1.59
Density Ratio	%	98.0
Optimum Moisture Content	%	22.0
Initial Moisture	%	22.1
Moisture Ratio	%	100
% Retained 37.0mm	%	0
Specimen Height	mm	49.8
Specimen Diameter	mm	50.9
Height : Diameter Ratio	-	0.98
Cell Pressure	kPa	560
Top Back Pressure	kPa	520
Base Back Pressure	kPa	500
Mean Effective Stress	kPa	50
Head Pressure	kPa	20

Results	*Unit*	*Value*
Permeability (k)	m/sec	**8×10^{-11}**

Comments

N/A

Accredited for compliance with
ISO/IEC 17025 - Testing
NATA Accredited Laboratory Number:
15100

Approved Signature:

Ian Goldschmidt
Specialised Testing Manager

Specialised Testing - 1800 288 188

Determination of Permeability of a Soil Constant Head Method using a Flexible Wall Permeameter

Test Method: AS1289.6.7.3

Report Number: P244030-1
Sample Number: 24-32320B
Sample Source: BH 10, Depth: 1.2-1.6m

Sample Date: 25/01/2024
Test Date: 1/03/2024
Report Date: 13/03/2024

Project Name: Proposed Residential Development - Rosedale
Client: J & A Geotech Testing Pty Ltd
Sampling Method: Sampled by Client - The results apply to the sample received
Sample Description: CLAY; brown, with sand, trace gravel
Specimen State: Disturbed
Permeant Used: Sydney tap water

Test Details	*Unit*	*Value*
Standard Maximum Dry Density	t/m^3	1.58
Initial Dry Density	t/m^3	1.55
Density Ratio	%	98.0
Optimum Moisture Content	%	25.0
Initial Moisture	%	24.9
Moisture Ratio	%	100
% Retained 37.0mm	%	0
Specimen Height	mm	49.8
Specimen Diameter	mm	50.9
Height : Diameter Ratio	-	0.98
Cell Pressure	kPa	560
Top Back Pressure	kPa	520
Base Back Pressure	kPa	500
Mean Effective Stress	kPa	50
Head Pressure	kPa	20

Results	*Unit*	*Value*
Permeability (k)	m/sec	**2×10^{-10}**

Comments

N/A

Accredited for compliance with
ISO/IEC 17025 - Testing
NATA Accredited Laboratory Number:
15100

Approved Signature:

Ian Goldschmidt
Specialised Testing Manager

FORTIFY
GEOTECH

Appendix C

Definitions of Geotechnical Engineering Terms

Limitations in the Use and Interpretation of this Geotechnical Report

Our Professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross- sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observes in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and the recommendations considering the changed conditions and time lapse.

The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Soil conditions at the other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report: nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

DESCRIPTION AND CLASSIFICATION OF SOIL

The methods of description and classification of soils used in this report are based on the Australian Standard 1726 – 2017, Geotechnical site investigations. In general, soils are described along the following characteristics: soil name, plasticity or behavioural or particle characteristics of the primary soil component, colour, secondary soil components' plasticity or behavioural or particle characteristics, condition, structure, inclusions, strength or density and origin.

GENERAL DEFINITION - SOIL

SOIL In engineering usage, soil is a natural aggregate of mineral grains which can be separated by such gentle mechanical means as agitation in water, can be remoulded and can be classified according to the Unified Soil Classification System.

SOIL ORIGIN

Soil origins fall into the following categories:

Residual soil:	Soils which have been formed in-situ by the chemical weathering of parent rock. These soils no longer retain any visible structure or fabric of the parent soil or rock material.
Extremely weathered material:	Formed directly from in situ weathering of geological formations. Although this material of soil strength it retains the structure and/or fabric of the parent rock material.
Alluvial soil:	Deposited by streams and rivers.
Estuarine soil:	Deposited in coastal estuaries, and including sediments carried by inflowing rivers and streams, and tidal currents.
Marine soil:	Deposited in a marine environment.
Lacustrine soil:	Deposited in freshwater lakes.
Aeolian soil:	Carried and deposited by wind.
Colluvial soil:	Soil and rock debris transported down slopes by gravity, with or without the assistance of flowing water.
Topsoil:	Mantle of surface and/or near-surface soil often but not always defined by high levels of organic material, both dead and living.
Fill:	Any material which has been placed by anthropogenic processes.

SOIL CLASSIFICATION

PARTICLE SIZE DEFINITIONS

Soil components are described according to the predominating particle size, qualified by the grading of other particles present (e.g. sandy clay) on the following basis:

Classification	Components	Subdivision	Particle Size (mm)
Oversize	Boulders		>200
	Cobbles		63 to 200
Coarse grained soil	Gravel	Coarse	19 to 63
		Medium	6.7 to 19
		Fine	2.36 to 6.7
	Sand	Coarse	0.6 to 2.36
		Medium	0.21 to 0.6
		Fine	0.075 to 0.21
Fine grained soil	Silt		0.002 to 0.075
	Clay		<0.002

MOISTURE CONDITION

Coarse Grained Soil		**Fine Grained Soil**	
Dry (D)	Non-cohesive and free-running.	Moist, dry of plastic limit ($w<W_P$)	Hard and friable or powdery.
Moist (M)	Soil feels cool, darkened in colour. Soil tends to stick together.	Moist, near plastic limit ($w \approx W_P$)	Soils can be moulded at a moisture content approximately equal to the plastic limit.
Wet (W)	As for moist, with free water forming when handled.	Moist, wet of plastic limit ($w>W_P$)	Soils usually weakened and free water forms on hands when handling.
		Wet, near liquid limit ($w \approx W_L$)	Near liquid limit.
		Wet, wet of liquid limit ($w>W_L$)	Wet of liquid limit.

CONSISTENCY/RELATIVE DENSITY

Cohesive soils are classified on the ease by which the soil can be remoulded and can be either assessed in the field by tactile means, by laboratory testing or through mechanical determination methods. Non-cohesive soils are classified on the basis of relative density, generally from the results of in-situ penetration tests and terms for both are defined as below:

Cohesive Soils			**Non-cohesive Soils**	
Consistency	**Indicative Undrained Shear Strength s_u(kPa)**	**Field Guide to Consistency**	**Term**	**Relative Density (%)**
Very soft (VS)	≤12	Exudes between the fingers when squeezed in hand.	Very Loose (VL)	≤15
Soft (S)	>12 - ≤25	Can be moulded by light finger pressure.	Loose (L)	>15 - ≤35
Firm (F)	>25 - ≤50	Can be moulded by strong finger pressure.	Medium Dense (MD)	>35 - ≤65
Stiff (St)	>50 - ≤100	Cannot be moulded by fingers.	Dense (D)	>65 - ≤85
Very Stiff (VSt)	>100 - ≤200	Can be indented by thumb nail.	Very Dense (VD)	>85
Hard (H)	>200	Can be indented with difficulty by thumb nail.		
Friable (Fr)	-	Can be easily crumbled or broken into small pieces by hand.		

MINOR COMPONENTS

Descriptive Term	Assessment Guide	Proportion of minor component in:
With	Easily detectable by visual or tactile means and little difference between general properties and properties of primary component.	Coarse grained soils: Fines – 5 to 12% Accessory coarse component – 15 to 30% Fine grained soils: Coarse component - 15 to 30%
Trace	Detectable by visual or tactile means but little or no difference between general properties and properties of primary component.	Coarse grained soils: Fines – <5% Accessory coarse component – <15% Fine grained soils: Coarse component - <15%

CEMENTATION

Where cementation is present in soils, they can be either weakly cemented where they are easily disaggregated by hand in air or water or moderately cemented where effort is required to disaggregate the soil by hand in air or water.

SAMPLING

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are generally taken by one of two methods:

1. Driving or pushing a thin walled sample tube into the soil and withdrawing with a sample of soil in a relatively undisturbed state.
2. Core drilling using a retractable inner tube (R.I.T.) core barrel.

Such samples yield information on structure and strength in additions to that obtained from disturbed samples and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

PENETRATION TESTING

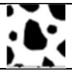
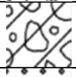
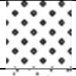
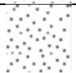
The relative density of non-cohesive soils is generally assessed by in-situ penetration tests, the most common of which is the standard penetration test. The test procedure is described in Australian Standard 1289 “Testing Soils for Engineering Purposes” – Test No. F3.1.

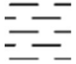
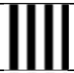
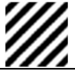
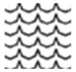
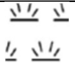
The standard penetration test is carried out by driving a 50mm diameter split tube penetrometer of standard dimensions under the impact of a 63kg hammer having a free fall of 750mm.

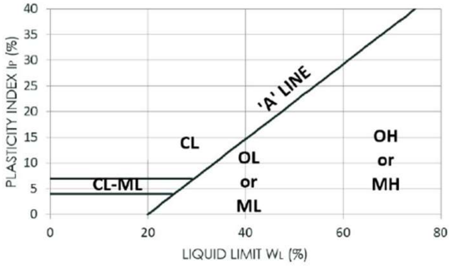
The “N” value is determined as the number of blows to achieve 300mm of penetration (generally after disregarding the first 150mm penetration through possibly disturbed material). The results of these tests can be related empirically to the engineering properties of the soil.

The test is also used to provide useful information in cohesive soils under certain conditions, a good quality disturbed sample being recovered with each test. Other forms of in situ testing are used under certain conditions and where this occurs, details are given in the report.

Unified Soil Classification System (Metricated)
Data for Description Identification and Classification of Soils

MAJOR DIVISIONS				DESCRPTION				FIELD IDENTIFICATION								LABORATORY CLASSIFICATION					
				Group Symbol	Graphic Symbol	TYPICAL NAME	DESCRIPTIVE DATA				GRAVELS AND SANDS				Group Symbol		% < 0.075 mm	PLASTICITY OF FINE FRACTION	Coefficient of Uniformity C_U	Coefficient of Curvature C_C	Notes
											GRADATIONS		NATURE OF FINES	DRY STRENGTH							
COARSE GRAINED SOILS	More than 65% by dry mass, less than 63mm is greater than 0.075mm.	GRAVELS	More than 50% of coarse grains are greater than 2.36mm.	GW		Well graded gravels and gravel-sand mixtures, little or no fines	Give soil name, indicate approximate percentages of sand and gravel, particle characteristics including particle size subdivision, particle shape, colour, secondary component characteristics and other pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure including zoning, defects and cementing, moisture condition, and relative density. Example: (SP) SAND, trace silt, grey, medium grained, medium dense; dry; Tomago Sand Beds.	COARSE GRAINED SOILS	More than 65% of material less than 63mm is greater than 0.075mm.	A 0.075mm particle is about the smallest particle visible to the naked eye.	GOOD	Wide range in grain size	"Clean" materials (not enough fines to bond coarse grains)	None	GW	Use the gradation curve of material passing 63mm for classification of fractions according to criteria for major component.	0-5	-	>4	Between 1 and 3	1. Identify fines by the method given for fine grained soils. 2. For fines contents between 5% and 12%, the soil shall be given a dual classification comprising the two group symbols separated by a dash, e.g. for a gravel with between 5% and 12% silt fines, the classification is GP-GM. 3. Soils that are dominated by boulders, cobbles or peat (Pt) are described separately and are not classified.
				GP		Poorly graded gravels and gravel-sand mixtures, little or no fines					POOR	Predominantly one size or range of sizes			GP		0-5	-	Fails to comply with above		
		GRAVELLY SOILS		GM		Silty gravels, gravel-sand-silt mixtures					GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are silty (1)	None to medium	GM		12-50	Below 'A' line and I_P >7	-	-	
				GC		Clayey gravels gravel-sand-clay mixtures							Fines are clayey (1)	Medium to high	GC		12-50	Above 'A' line and I_P >7	-	-	
		SANDS	More than 50% of coarse grains are less than 2.36mm.	SW		Well graded sands and gravelly sands, little or no fines					GOOD	Wide range in grain size	"Clean" materials (not enough fines to bond coarse grains)	None	SW		0-5	-	>6	Between 1 and 3	
				SP		Poorly graded sands, little or no fines					POOR	Predominantly one size or range of sizes			SP		0-5	-	Fails to comply with above		
		SANDY SOILS		SM		Silty sand, sand-silt mixtures					GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are silty (1)	None to medium	SM		12-50	Below 'A' line or I_P <4	-	-	
				SC		Clayey sands, sand-clay mixtures							Fines are clayey (1)	Medium to high	SC		12-50	Above 'A' line and I_P >7	-	-	

										SILT AND CLAY FRACTION						
										Fraction smaller than 0.2 mm AS sieve size						
										DRY STRENGTH	DILANTANCY	TOUGHNESS				
FINE GRAINED SOILS	More than 35% by dry mass, less than 63mm is less than 0.075mm.	Liquid Limit less than 50%.	ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Give soil name, indicate degree and character of plasticity, colour, secondary component characteristics other pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure including zoning, defects and cementing, moisture condition, and consistency. Example: (CI) CLAY, with gravel, red-brown, medium plasticity, very stiff; gravel 20%, fine to medium, sub-rounded; moist, with desiccation cracks; residual.	FINE GRAINED SOILS	More than 35% of material less than 63mm is smaller than 0.075mm.		None to low	Slow to rapid	Low	ML		More than 35% of material is less than 63mm passing 0.075mm.	Below 'A' line
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays					Medium to high	None to slow	Medium	CL, CI			Above 'A' line
			OL		Organic silts and organic silty clays of low plasticity					Low to medium	Slow	Low	OL			Below 'A' line
		Liquid Limit more than 50%.	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts					Low to medium	None to slow	Low to medium	MH			Below 'A' line
			CH		Inorganic clays of high plasticity, fat clays					High to very high	None	High	CH			Above 'A' line
			OH		Organic clays of medium to high plasticity					High to high	None to very slow	Low to medium	OH			Below 'A' line
			Pt		Peat muck and other highly organic soils		Readily identified by colour, odour, spongy feel and generally fibrous texture						PT		* Effervescence with H_2O_2	



PLASTICITY CHART
FOR CLASSIFICATION
OF FINE GRAINED SOILS

DESCRIPTION AND CLASSIFICATION OF ROCK

The methods of description and classification of rock used in this report are based on the Australian Standard 1726 – 2017, Geotechnical site investigations. In general, descriptions cover the following properties for rock – rock name, grain size, colour, fabric and texture, inclusions or minor components, moisture content, durability, rock material condition including strength and weathering and/or alteration, defects and geological description.

GENERAL DEFINITIONS – ROCK

ROCK In engineering usage, rock is a natural aggregate of minerals connected by strong and permanent cohesive forces. Since “strong” and “permanent” are subject to different interpretations, the boundary between rock and soil is necessarily an arbitrary one. Rock material is intact rock that is bounded by defects.

DEFECT Discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength.

STRUCTURE The nature and configuration of the different defects within the rock mass and their relationship to each other.

ROCK MASS The entirety of the system formed by all of the rock material and all the defects that are present.

DESCRIPTIVE TERMS

ROCK NAME Simple rock names are used rather than precise geological classification. Rock names fall into category types of sedimentary rocks, igneous rocks, metamorphic rocks and duricrust rocks.

PARTICLE SIZE

Grain size terms for sedimentary rocks with predominantly sand sized grains are:

Coarse grained – mainly 0.6mm to 2mm.

Medium grained – mainly 0.2mm to 0.6mm.

Fine grained – mainly 0.06mm (just visible) to 0.2mm.

In igneous and metamorphic rock types, where significant, the following terms are used to describe the dominant or average grain size and/or the grain size may be recorded in millimetres:

Coarse grained – mainly greater than 2mm.

Medium grained – mainly 0.06mm to 2mm.

Fine grained – mainly less than 0.06mm (just visible).

If readily identifiable, the minerals should be described.

FABRIC

When the arrangement of grains shows an alignment, a preferred orientation or a layering that is visible, descriptive terms for sedimentary rocks are bedding and lamination. Bedding is layering produced by changes in sedimentation. Lamination is similar to bedding but developed in layer thicknesses of less than 20mm. Fabric descriptive terms for metamorphic rocks are foliation, which is the parallel arrangement of minerals due to metamorphic processes and cleavage, which is a type of foliation developed in fine grained metamorphic rocks such as slates. For igneous rocks, flow banding is a layering produced during flow of a partially solidified igneous rock that causes crystals to become oriented.

INDISTINCT FABRIC

Where layering or fabric is just visible. There is little effect on strength properties.

DISTINCT FABRIC

Where layering or fabric is easily visible. The rock may break more easily parallel to the fabric.

ROCK WEATHERING DEFINITIONS

Extremely Weathered (XW)	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Soil Classification System, but the texture of the original rock is still evident.
Highly Weathered (HW)	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of the chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered (MW)	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered (SW)	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance, usually limonite, has taken place. The colour and texture of fresh rock is recognisable.
Fresh (FR)	Rock substance unaffected by weathering.

The degrees of rock weathering may be gradational. Intermediate stages are described by dual symbols with the prominent degree of weathering first (e.g. EW-HW).

The various degrees of weathering do not necessarily define strength parameters as some rocks are of low strength, even when fresh, to the extent that they can be broken by hand across the fabric, and some rocks may increase in strength during the weathering process.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics.

Term	**Point Load Strength Index $I_{s(50)}$ MPa**	**Field Guide**	**Approx Unconfined Compressive Strength MPa***
Very Low Strength (VL)	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.	0.6 to 2
Low Strength (L)	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	2 to 6
Medium Strength (M)	0.3 to 1	Readily scored with a knife; a piece of core 150mm long x 50mm dia. can be broken by hand with difficulty.	6 to 20
High Strength (H)	1 to 3	A piece of core 150mm long x 50mm dia. cannot be broken by hand but can be broken by a pick with a single firm blow, rock rings under hammer.	20 to 60
Very High Strength (VH)	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 to 200
Extremely High Strength (EH)	more than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.	more than 200

ROCK DEFECT TYPES

This classification applies to the range of possible rock defect types that are types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term		Description	Diagram
Parting		A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.	
Joint		A surface or crack with no apparent shear displacement an across which the rock has little or no tensile strength, but which is not parallel to layering or to planar anisotropy in the rock material. May be open or closed.	
Sheared Surface		A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.	
Sheared Zone		Zone of rock material with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
Seams	Sheared Seam	Seam of soil material with roughly parallel almost planar boundaries, composed of soil materials with roughly parallel near planar, cuved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge-shaped blocks.	
	Crushed Seam	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.	
	Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as a veneer or coating on a joint surface.	
	Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.	

The spacing, length (sometimes called persistence), aperture (openness), and seam thickness should generally be described directly in millimetres or metres.

ROCK DEFECT DESCRIPTIONS

DEFECT ROUGHNESS TERMS		DEFECT SHAPE TERMS		DEFECT COATING TERMS	
Term	**Description**	**Term**	**Description**	**Term**	**Description**
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.	Planar	The defect does not vary in orientation.	Clean	No visible coating.
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.	Curved	The defect has a gradual change in orientation.	Stained	No visible coating but surfaces are discoloured.
Smooth	Smooth to touch. Few or no surface irregularities.	Undulating	The defect has a wavy surface.	Veneer	A visible coating or soil or mineral, too thin to measure; may be patchy.
Polished	Shiny smooth surface.	Stepped	The defect has one or more well defined steps.	Coating	A visible coating up to 1mm thick. Thicker soil material should be described using appropriate defect terms (e.g. infilled seam). Thicker rock strength material should be described as a vein.
Slickensided	Grooved or striated surface, usually polished.	Irregular	The defect has many sharp changes of orientation.		

Appendix D

Flowchart of Landslide Risk Management, Guidelines for Hillside Construction

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or L (5)
B - LIKELY	10^{-2}	VH	VH	H	M	L
C - POSSIBLE	10^{-3}	VH	H	M	M	VL
D - UNLIKELY	10^{-4}	H	M	L	L	VL
E - RARE	10^{-5}	M	L	L	VL	VL
F - BARELY CREDIBLE	10^{-6}	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Attachment 1 – Risk Assessment Matrix

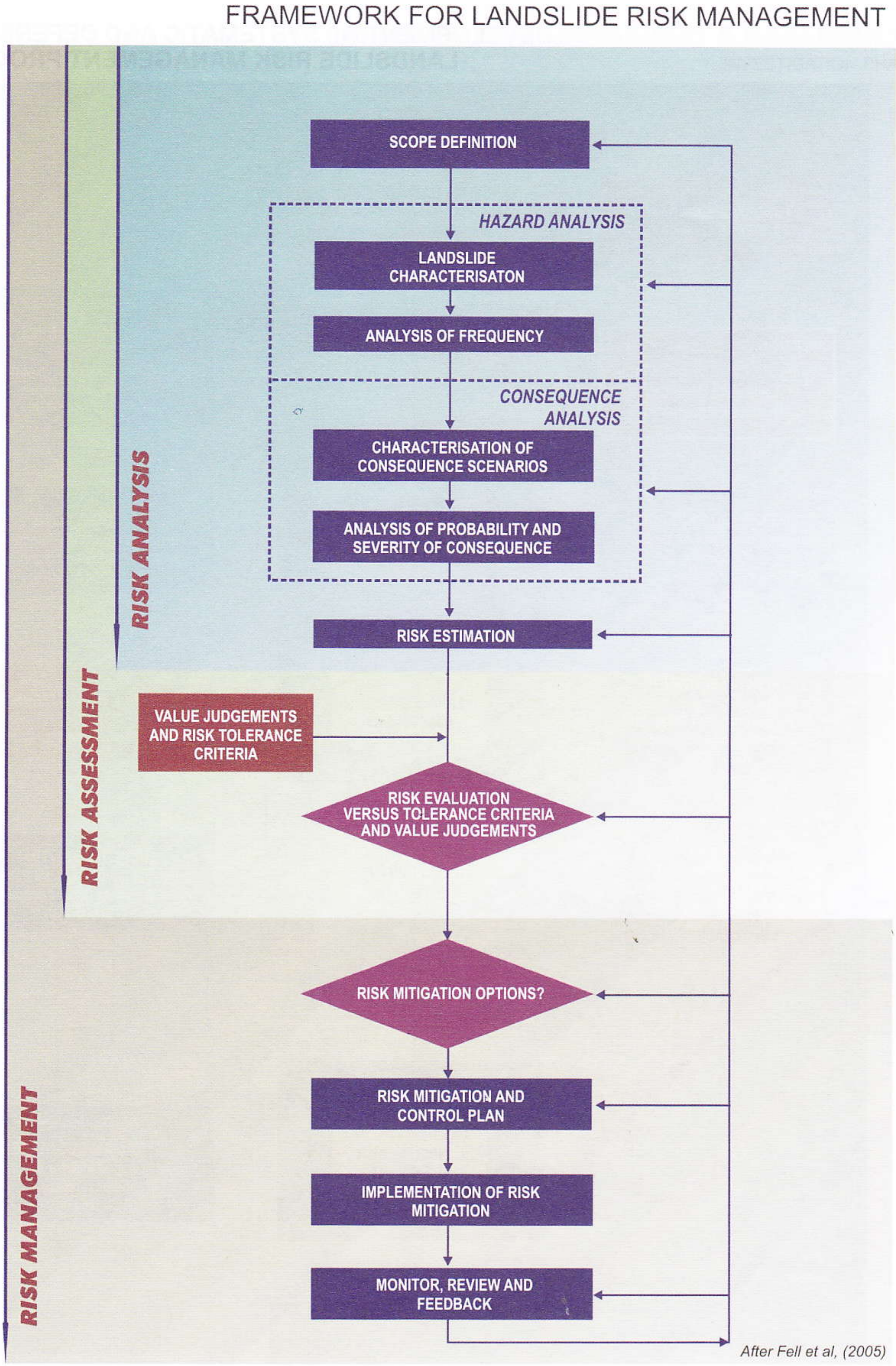
E – Extreme risk – detailed action plan required
H - High risk – needs senior management attention
M – Medium risk – specify management responsibility
L – Low risk – manage by routine procedures

High or **Extreme** risks must be reported to Senior Management and require detailed treatment plans to reduce the risk to **Low** or **Medium**.

	Consequence				
People	Injuries or ailments not requiring medical treatment.	Minor injury or First Aid Treatment Case.	Serious injury causing hospitalisation or multiple medical treatment cases.	Life threatening injury or multiple serious injuries causing hospitalisation.	Death or multiple life threatening injuries.
Reputation	Internal Review	Scrutiny required by internal committees or internal audit to prevent escalation.	Scrutiny required by external committees or ACT Auditor General's Office, or inquest, etc.	Intense public, political and media scrutiny. Eg: front page headlines, TV, etc.	Assembly inquiry or Commission of inquiry or adverse national media.
Business Process & Systems	Minor errors in systems or processes requiring corrective action, or minor delay without impact on overall schedule.	Policy procedural rule occasionally not met or services do not fully meet needs.	One or more key accountability requirements not met. Inconvenient but not client welfare threatening.	Strategies not consistent with Government's agenda. Trends show service is degraded.	Critical system failure, bad policy advice or ongoing non-compliance. Business severely affected.
Financial	1% of Budget or <$5K	2.5% of Budget or <$50K	> 5% of Budget or <$500K	> 10% of Budget or <$5M	>25% of Budget or >$5M
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**

Likelihood	**Probability:**	**Historical:**			**1**	**2**	**3**	**4**	**5**
	>1 in 10	Is expected to occur in most circumstances	**5**	**Almost Certain**	**M**	**H**	**H**	**E**	**E**
	1 in 10 - 100	Will probably occur	**4**	**Likely**	**M**	**M**	**H**	**H**	**E**
	1 in 100 – 1,000	Might occur at some time in the future	**3**	**Possible**	**L**	**M**	**M**	**H**	**E**
	1 in 1,000 – 10,000	Could occur but doubtful	**2**	**Unlikely**	**L**	**M**	**M**	**H**	**H**
	1 in 10,000 – 100,000	May occur but only in exceptional circumstances	**1**	**Rare**	**L**	**L**	**M**	**M**	**H**

Adapted from Standards Australia Risk Management AS/NZS 4360: 2004



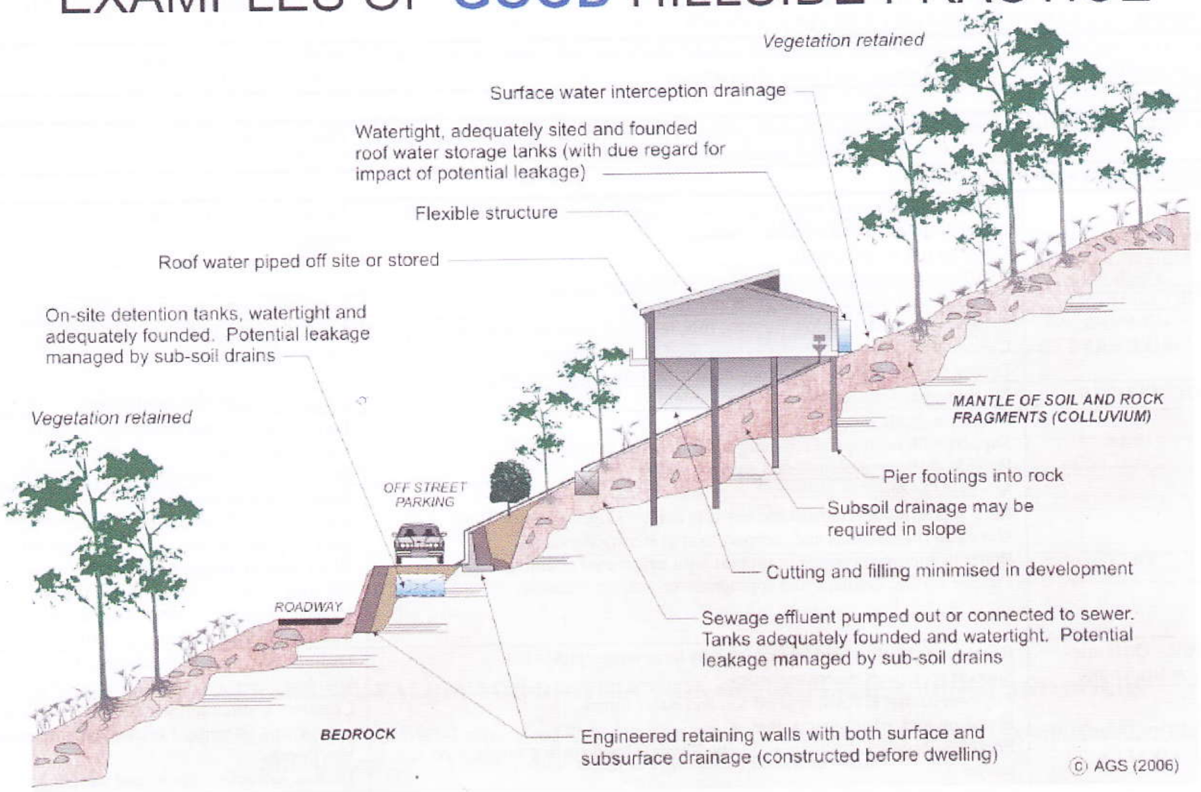
After Fell et al, (2005)

Figure 2: Abbreviated flowchart for Landslide Risk Management.
Ref: AGS (2007a, 2007c)

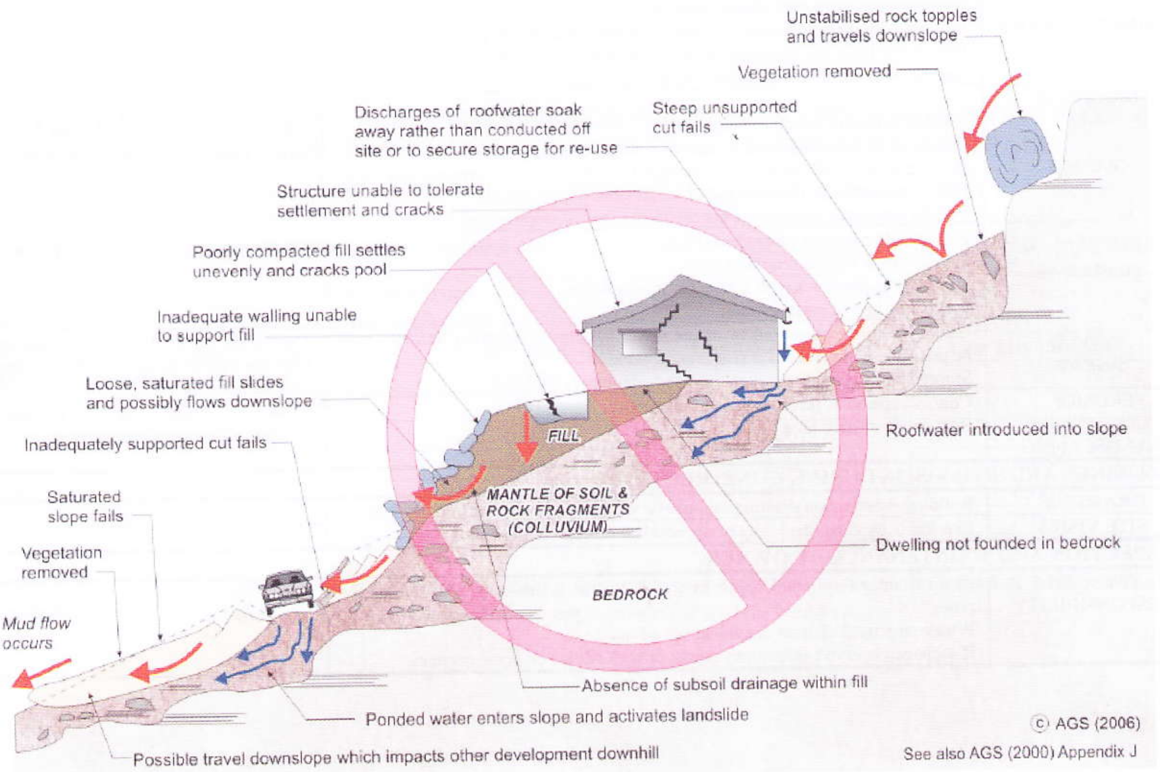
APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

ADVICE	*GOOD ENGINEERING PRACTICE*	*POOR ENGINEERING PRACTICE*
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminatory bulk earthworks.
Cuts	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
Fills	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
Rock Outcrops & Boulders	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
Surface	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
Subsurface	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
Septic & Sullage	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE



FORTIFY
GEOTECH

Appendix E

Concept Subdivision Plan and Bulk Earthworks Cut and Fill Plan

Concept Subdivision Plan

LAND USE AND DEVELOPMENT LOTS

The Centre Zone
Height: Maximum 2 Storeys
Typical Lot Size: 100m² - + 450m²
Number of lots: 40

The General Zone
Height: Maximum 2 Storeys
Typical Lot Size: 450m² - 1,000m²
Number of lots: 119

The Suburban Zone
Height: Maximum 2 Storeys
Typical Lot Size: 450m² - 2,000m²
Number of lots: 177

The Park Edge Zone
Height: Maximum 2 Storeys
Typical Lot Size: 700m² - 1,500m²
Number of lots: 181

The Outlook Zone
Height: Maximum 2 Storeys
Typical Lot Size: 1,000m² - 10,000m²
Number of lots: 224

TOTAL LOTS 741

Deferred Super Lot Area
Area of future residential development subject to separate Development Application and further agreement with Council in relation to Odour and Noise operation of the STP

ROADS:

- Distributor Road - 25m
- Collector Street - 18.5m
- Access Street - 17m
- Local Street - 18.5m
- Perimeter Street - 17m
- Evacuation Access Road -10.2m

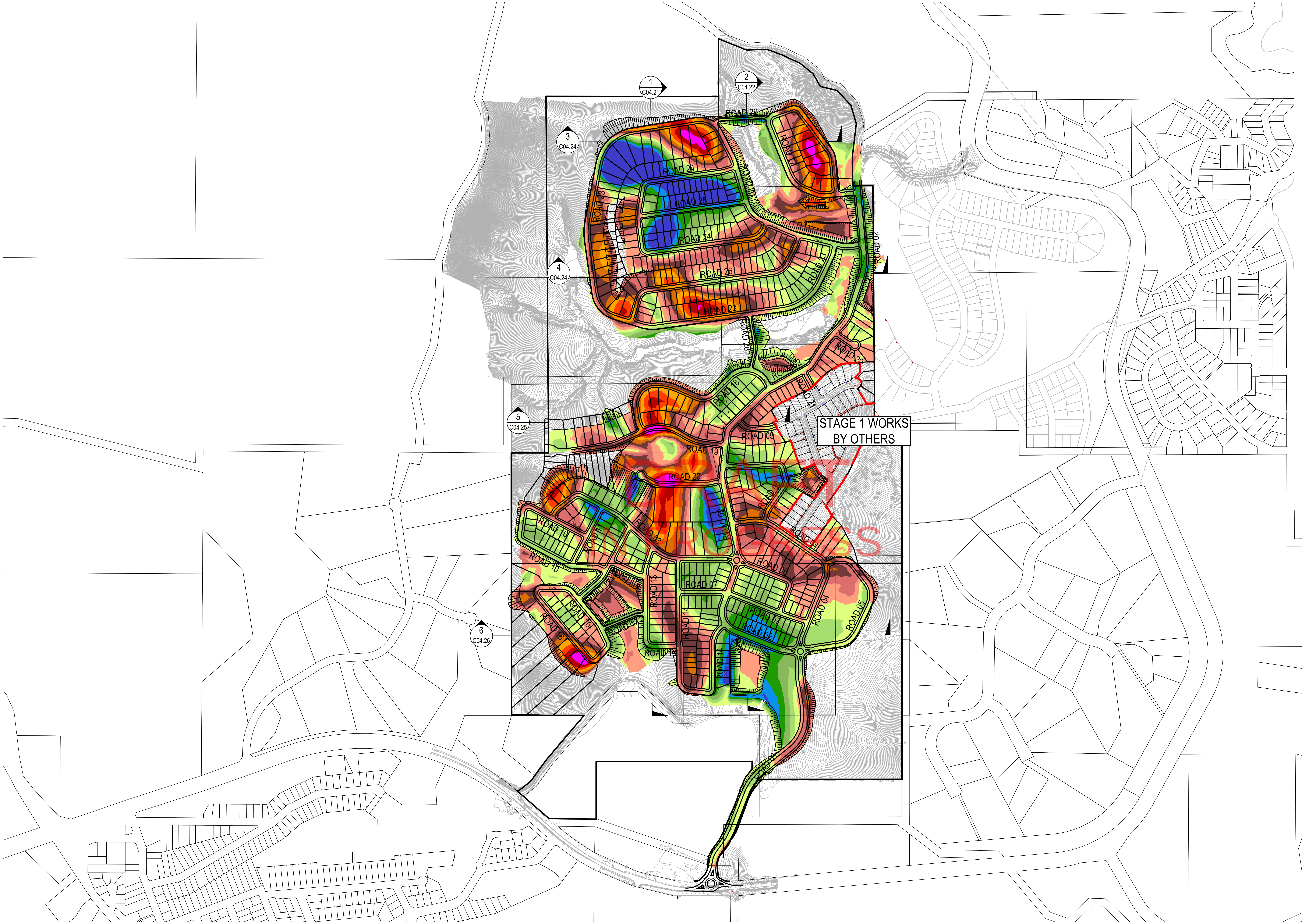
OTHERS:

- Non Developable Land/ Retained Managed Land
- Open Space, Recreation and/or Facilities
- Rural Lot
- Contours at 2m intervals
- Lakes and Dams
- Bevian Wetland
- Application Boundary

BEVIAN ROAD- Modified Concept Application

Date
June 2024

Drawing number
AA_01



LEGEND

🟪	GREATER THAN 7.0m CUT
🟥	6.0m TO 7.0m CUT
🟥	5.0m TO 6.0m CUT
🟧	4.0m TO 5.0m CUT
🟧	3.0m TO 4.0m CUT
🟫	2.0m TO 3.0m CUT
🟥	1.0m TO 2.0m CUT
🟧	0.0m TO 1.0m CUT
🟨	0.0m TO 1.0m FILL
🟩	1.0m TO 2.0m FILL
🟩	2.0m TO 3.0m FILL
🟩	3.0m TO 4.0m FILL
🟦	4.0m TO 5.0m FILL
🟦	GREATER THAN 5.0m FILL

NOTES

1. NO ALLOWANCE HAS BEEN MADE FOR BULKING FACTORS. NOTE ALL VOLUMES DEPICTED ARE SOLID VOLUMES ONLY AND MAY NOT REFLECT DETAILED EARTHWORKS.
2. NO ALLOWANCE HAS BEEN MADE FOR DETAILED EARTHWORKS. ie SERVICE TRENCHING, DETAILED EXCAVATION AND THE LIKE.
3. APPROXIMATE BULK EARTHWORKS VALUES AS FOLLOWS;
   CUT 1,097,715m^3
   FILL 1,058,616m^3
   BALANCE 39,099m^3 (EXPORT)
4. VOLUMES BASED ON;
   TOPSOIL STRIP 200mm

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
1	R.I.P	REVISION IN PROGRESS	CB	MTL		MTL

Client

walker

Scale

0 100 200 300 400 500m

SCALE 1:5000 @A1

North

N

enspire

Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135 enspiresolutions.com.au

Project
73 BEVIAN ROAD
ROSEDALE NSW 2536
CIVIL ENGINEERING WORKS

Title
BULK EARTHWORKS
CUT AND FILL PLAN

Scale: 1:5000
Date: R.I.P
Size: A1
Datum: MGA 2020

Status
FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 210123-00-C-C04.01

Revision: 1

DATE PLOTTED: 19 March 2024 6:25 PM BY : ELARIA ZAKI

CAD File: P:\210123 73BevianRoad\D-Civil\00-SiteWide\Drawings\6-DACC\210123-00-C-C04.01 BULK EARTHWORKS CUT AND FILL PLAN.dwg