GEOTECHNIQUE® PTY LTD

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Opal Health Care
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Email: marlon@cyreprojects.com.au

Attention: Mr M Zunac

Dear Sir

re: **Proposed Narwee Parkland Care Community**
59-67 Karne Street North, Narwee
Geotechnical Investigation

This report presents results of a geotechnical investigation carried out for the proposed development at the above site. The investigation was carried out in general accordance with Australian Standard AS2176 (Reference 1).

We understand that the proposed development at the site includes demolition of existing structures and construction of a new building with three storeys above ground and one level of basement. Construction of the proposed building is anticipated to involve up to about 4.5m to 6.5m deep excavations and some fill placement. Plan showing outline of basement excavation is attached.

Previously the proposed development was proposed to cover 59-65 Karne Street North, Narwee, for which Geotechnique Pty Ltd completed a geotechnical investigation and prepared Report No 13977/3-AA dated 31 March 2016 (Reference 2). However, we now understand that the proposed development will include 67 Karne Street North as well so that the proposed development will cover 59-67 Karne Street North, Narwee.

This report is based on Report No 13977/3-AA (Reference 2) and results of additional geotechnical investigation carried out in 67 Karne Street North. However, relevant information in Reference 2 is reproduced in this report so that this report can be read independently.

This report provides the following:

- Assessment of subsurface conditions across proposed development site covering 59-67 Karne Street North, Narwee
- Geotechnical recommendations on the design of basement excavation, retaining structures, floor slabs, footings and pavement of the proposed development covering 59-67 Karne Street North, Narwee

Available Information

Reference to the Geological Map of Sydney (scale 1:100,000) indicates that the bedrock at the site is Ashfield Shale, belonging to the Wianamatta Group of rocks and comprising dark grey to black shale and laminite.

Reference to the Soil Landscape Map of Sydney (scale 1:100,000) indicates that the landscape at the site belongs to the Blacktown Group, which is characterised by gently undulating rises on Wianamatta Group shales, with local relief to 30m, ground slope less than 5 percent and broad rounded crests. The sub-surface soil in this landscape is likely to be up to 3.0m thick, moderately reactive, highly plastic and with poor drainage.

Field Work

Field works for preparation of Reference 2 were carried out on 16 and 17 March 2017 and that for additional geotechnical investigation in 67 Karne Street were carried out 29 June 2022. Field works included the following:

- Carry out a walk over survey to assess existing site conditions.
- Reviewing services plans obtained from “Dial Before You Dig” to determine locations of services across the site.
- Scanning boreholes locations for underground services to ensure that services were not damaged during field work. We engaged a specialist services locator for this purpose.
- Drilling six boreholes (BH1 to BH6) uniformly distributed in accessible portions of site in 2016 and drilling of two more boreholes (BH101 and BH102) during current investigation. Boreholes were initially drilled to V-bit or TC-bit refusal in bedrock at depths of 2.5m and 3.5m from existing ground surface and then continued to depths of 5.0m to 5.5m by rock coring. The approximate borehole locations are indicated on the attached Drawing No 20219/1-AA1. Engineering borehole logs and photographs of rock cores are also attached.
- Conducting Standard Penetration Test (SPT) in the boreholes to assess strength characteristics of sub-surface soils.
- Recovering representative soil samples for visual assessment and laboratory tests.
- Measuring depths to groundwater level or seepage in the boreholes, where encountered.
- Backfilling boreholes with recovered materials after logging and sampling.

Field works were supervised by a Field Engineer from this company who was responsible for nominating the borehole locations, supervision of SPT tests, sampling and preparation of field logs.

Site Description

The following observations were made during field works in 2022.

- The site is of irregular shape (L-shaped), measuring approximately 60.0m to 120.0m in length and 40.0m to 77.0m in width.
- The site is bound by existing residential developments to the north and east, Karne Street, Narwee, to the west and a reserve to the south.
- Natural ground surface across the site is sloping towards the south west at about 4 to 5 degrees.

- Most of structures within 59-63 Karne Street North observed during 2017 have now been demolished and the site has been cleared. However, there still were existing dwellings in 65 and 67 Karne Street North.

Subsurface Conditions

Sub-surface profiles encountered in the boreholes are detailed in the attached logs and summarised below in Table 1:

Table 1 – Sub-surface Profiles encountered in Boreholes

Borehole Drilling Date	Borehole No	Termination Depth* (m)	Depth Range for Topsoil/Fill* (m)	Depth Range for Residual Soil* (m)	Depth to Bedrock* (m)
2017	BH1	5.5	0.0-0.3	0.3-1.3	1.3
	BH2	5.0	0.0-0.2	0.2-1.3	1.3
	BH3	5.2	0.0-0.2	0.2-2.0	2.0
	BH4	5.0	0.0-0.1	0.1-1.4	1.4
	BH5	5.0	0.0-0.5	0.5-2.0	2.0
	BH6	5.0	0.0-1.0	1.0-2.7	2.7
2022	BH101	5.3	0.0-0.4	0.4-1.6	1.6
	BH102	5.0	0.0-0.7	0.7-1.4	1.4

* Approximate only

Table 1 indicates that the sub-surface profile across the site comprises a sequence of topsoil/fill and residual soils underlain by bedrock. The depth to bedrock across the site is likely to vary from about 1.3m to 2.7m from existing ground surface. The subsurface materials may in general be described as follows:

Topsoil Silty CLAY, Sandy CLAY, low to medium plasticity, brown, grey, with some gravel & roots

Fill Silty Sandy CLAY, Silty CLAY, Gravelly Silty CLAY, low to medium plasticity, dark grey, brown, with fine grained sand, traces of gravel and roots

Gravelly SAND, medium grained, yellow

Some boreholes were located in paved areas and these boreholes encountered about 50mm to 100mm thick concrete

Residual Soil Silty CLAY, Sandy CLAY, low to medium plasticity, pale grey, pale brown, mottled red brown, moisture content lower than plastic limit, soft to stiff

Shaley CLAY, medium plasticity, brown, grey, moisture content lower than plastic limit, stiff to very stiff, with ironstone

Bedrock SHALE/SILTSTONE, pale brown, pale grey, interbedded lamination/thinly bedded, extremely to moderately weathered, very low to medium strength

Groundwater Conditions

Groundwater level was not encountered to V-bit/TC-bit refusal depths of about 2.5m to 3.5m from existing ground surface. Water used for coring precluded measurement of groundwater level at completion of cored hole drilling. However, based on observation during drilling, it is our assessment that the depth to groundwater level across the site is likely to be in excess of 6.5m. It should however be noted that the fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors not evident during drilling.

Laboratory Testing

Representative soil samples recovered from boreholes were tested in the NATA accredited laboratories of SGS Environmental Services and Geotech Testing for the following:

- Chemical properties to assess soil salinity and Aggressivity in terms Electrical Conductivity, pH, sulphate, chloride and resistivity.
- Chemical properties to assess acid sulphate soils in terms of pH of KCl extract (pH_{kcl}), pH of KCl extract after peroxide digestion (pH_{ox}), Total Potential Acidity (TPA), Total Actual Acidity (TAA), Total Sulphidic Acidity (TSA), Peroxide Oxidisable Sulphur (S_{POS}) and Chromium Reducible Sulphur (S_{cr}).
- Physical properties to assess compaction characteristics and strength of compacted soils in terms of maximum dry density, optimum moisture content and California Bearing Ratio (CBR).

Laboratory test results are attached and summaries are presented in the following Tables 2, 3 and 5:

Table 2 – Results of Soil Salinity and Aggressivity Tests

Sampling Date	Borehole No	Depth (m)	EC (µS/m)	pH	Sulphate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
2017	BH1	1.0-1.45	63	4.8	38.0	-	-
	BH1	2.5-2.6	66	6.0	69.0	-	-
	BH2	1.0-1.45	380	-	-	-	-
	BH2	2.5-2.6	320	-	-	-	-
	BH3	1.0-1.45	630	5.3	380.0	-	-
	BH3	2.5-2.95	200	8.2	51.0	-	-
	BH4	1.0-1.45	140	-	-	-	-
	BH4	2.5-2.6	240	-	-	-	-
	BH5	1.0-1.45	200	5.0	160.0	-	-
	BH5	2.5-2.65	250	5.3	70.0	-	-
	BH6	1.0-1.45	330	6.4	290.0	-	-
	BH6	3.5-3.6	150	8.6	52.0	-	-
2022	BH101	0.5-0.95	34	4.4	57	5.9	19000
	BH102	0.3-0.45	50	5.7	130	3.3	14000
	BH102	0.5-0.95	84	4.6	82	16	8400

Note: EC=Electrical Conductivity

Table 3 – Results of Acid Sulphate Soil Tests

Borehole No	Depth (m)	pH_{KCl}	pH_{ox}	TPA (pH6.5)	TAA (pH6.5)	TSA (pH6.5)	S_{POS} (% w/w)	Scr (% w/w)
BH101	0.5-0.95	3.8	4.4	140	122	17	0.009	<0.005
BH102	0.3-0.45	5.2	3.8	15	17	<5	0.008	<0.005
BH102	0.5-0.95	3.8	4.5	152	127	25	0.011	<0.005

Note

pH_{KCl} = pH of filtered 1:20, 1M K_{Cl} extract, overnight shake
pH_{ox} = pH of filtered 1:20, 1M K_{Cl} after peroxide digestion
TPA = Total Potential Acidity (mol H^+/tonne)
TAA = Total Actual Acidity (mol H^+/tonne)
TSA = Total Sulphidic Acidity (mol H^+/tonne)
S_{POS} = Peroxide Oxidisable Sulphur (%w/w)
S_{cr} = Chromium Reducible Sulphur (% w/w)
Limit of Reporting for TAA, TPA and TSA is 5 moles H^+/tonne, and for S_{POS} and S_{cr} is 0.005% w/w.

Table 4 – Results of Compaction and California Bearing Ratio (CBR) Tests

Borehole No	Sample Depth (m)	Field Moisture Content (%)	Optimum Moisture Content (%)	Maximum dry Density (t/m^3)	California Bearing Ratio (%)
BH2	0.5-0.8	21.4	19.9	1.71	3.0
BH3	0.5-0.8	25.7	22.4	1.62	4.0

Rock cores obtained from boreholes were photographed and tested at regular depth intervals for determination of Point Load Strength Index (I_{s50}). The point load strength indices for the rock cores and the assessed rock strengths, in accordance with Australian Standard AS1726-1993 (Reference 1), are summarised in the following Table 5:

Table 5 – Results of Point Load Strength Index Tests

Sampling Date	Borehole No	Depth (m)	Diametral $I_{s(50)}$ (MPa)	Axial $I_{s(50)}$ (MPa)	Diametral Assessed Strength	Axial Assessed Strength
2017	BH1	2.60	0.12	0.12	Low	Low
	BH1	3.50	0.06	0.30	Very Low	Medium
	BH1	4.50	0.12	0.03	Low	Extremely Low
	BH1	5.20	0.15	0.15	Low	Low
	BH2	2.60	0.06	0.12	Very Low	Low
	BH2	3.50	0.05	0.07	Very Low	Very Low
	BH2	4.70	0.02	0.08	Extremely Low	Very Low
	BH3	3.20	0.05	0.13	Very Low	Low
	BH3	4.30	0.66	1.22	Medium	High
	BH3	5.10	0.91	1.87	Medium	High
	BH4	3.50	0.05	0.31	Very Low	Medium
	BH4	4.50	0.10	0.61	Low	Medium
	BH5	3.80	0.11	0.30	Low	Medium
	BH5	4.50	0.21	0.14	Low	Low
	BH6	3.80	0.15	0.34	Low	Medium
	BH6	4.50	0.39	0.57	Medium	Medium
2022	BH101	2.93	0.08	0.68	Very Low	Medium
	BH101	3.39	0.30	0.28	Low	Low
	BH101	4.78	0.14	0.66	Low	Medium
	BH101	5.04	0.14	0.37	Low	Medium
	BH102	3.37	0.16	0.31	Low	Medium
	BH102	4.05	0.37	0.79	Medium	Medium
	BH102	4.74	0.16	1.53	Low	High

It should be noted that Point Load Strength tests could only be carried out on intact (stronger) portions of rock cores. Therefore, strength assessments presented in Table 5 indicate the upper limits of rock strengths.

Based on rock strengths (Table 4) and rock discontinuities shown in the borehole logs, bedrock from the proposed development site is classified for foundation design in accordance with Pells et al (Reference 3). The classifications of rock for each borehole are given in the following Table 6:

Table 6 – Rock Classification for Foundation Design

Borehole No	Depth Ranges for Different Rock Classes in Boreholes* (m)	
	Class V – Shale/Siltstone	Class IV- Shale/Siltstone
BH1	1.3-5.2	5.2->5.5
BH2	1.3->5.0	Not Encountered
BH3	2.0-4.3	4.3->5.2
BH4	1.4->5.0	Not Encountered
BH5	2.0->5.0	Not Encountered
BH6	2.7-4.9	4.9->5.0
BH101	1.6-4.6	4.6->5.3
BH102	1.4-3.2	3.2->5.0

* Approximate only from existing ground surface

Based on Table 6, bedrock at the base of the proposed basement excavation is anticipated to be Class V and IV shale/siltstone.

DISCUSSION AND RECOMMENDATIONS

Soil Salinity

Salinity refers to the presence of excess salt in the environment, either in soil or water. Salinity is a serious problem for any development due to the many environmental, economic and social impacts. Soil salinity is generally assessed by measuring Electrical Conductivity (EC) of a soil sample made up of 1:5 soil water suspension. Thus determined Electrical Conductivity (EC) is multiplied by a factor varying from 6 to 23, based on the texture of the soil sample, to obtain Equivalent Electrical Conductivity designated as EC_e (Reference 4). Alternatively, EC_e may also be directly measured in soil saturation extract. The criteria for assessment of soil salinity classes are shown in the following Table 7 (Reference 4).

Table 7 – Soil Salinity Classes

Classification	EC_e (dS/m)	Comments
Non-saline	<2	Salinity effects mostly negligible
Slightly saline	2 – 4	Yields of very sensitive crops may be affected
Moderately saline	4 – 8	Yields of many crops affected
Very saline	8 – 16	Only tolerant crops yield satisfactorily
Highly saline	>16	Only a few tolerant crops yield satisfactorily

Note 1 μS/cm=1000xdS/m

A multiplication factor of 8-10 is assessed to be appropriate for clayey soils encountered across the site. Even for a factor of 10, the Equivalent Electrical Conductivity (ECe) values for representative soil samples summarised in Table 2 are estimated to be in range of 0.34dS/m to 6.30dS/m. However, only one of 15 samples shows ECe value of more than 4.0dS/m. This is likely to be an anomaly in the site conditions or indication of a localised moderately saline soil, which is unlikely to cause salinity related problems for the proposed development.

Therefore, it is our assessment that the soils likely to be disturbed and/or excavated during proposed development works are non-saline. Therefore, earthworks for the proposed development works can be carried out without a Saline Soil Management Plan (SSMP).

Soil Aggressivity

Australian Standard AS2870 (Reference 5) provides guidelines to assess soil salinity and exposure classification for saline and sulphate soils. Table 8 below provides salinity and exposure classification based on Electrical Conductivity (EC_e) and Table 9 provides exposure classification for sulphate soils:

Table 8 – Exposure Classifications for Saline Soils

Electrical Conductivity, EC_e (dS/m)	Exposure Classification	Salinity Classification
<2	A1	Non-saline
2 – 4	A1	Slightly saline
4 – 8	A2	Moderately saline
8 – 16	B1	Very saline
>16	B2	Highly saline

Table 9 – Exposure Classifications for Sulphate Soils

Sulphate expressed as SO_3		pH	Exposure Classification*	
In Soil (ppm)	In Groundwater (ppm)		Soil Condition A	Soil Condition B
<5000	<1000	>5.5	A2	A1
5000-10000	1000-3000	4.5-5.5	B1	A2
10000-20000	3000-10000	4.0-4.5	B2	B1
>20000	>10000	<4.0	C2	B2

Approximately 100ppm of SO_4 = 80ppm of SO_3
*Soil Condition A = high permeability soils (e.g. sands and gravels) which are below groundwater
*Soil Condition B = low permeability soils (e.g. silts and clays) and all soils above groundwater

Soils across the site are clayey in nature and therefore appropriate site condition for predominant soils across the site is assessed to be “Condition B”. Based on laboratory test results presented in Table 2 and guidelines on Exposure Classification presented in Tables 8 and 9, the site is assessed to belong to Exposure Class A2. pH is dominant.

Therefore, we recommend that the proposed development use construction materials such as concrete and construction techniques that are appropriate for assessed Exposure Classification A2.

Aggressivity Classification

The Aggressivity Classification of soil and groundwater applicable to iron/steel and concrete piles, in accordance with Australian Standard AS2159 (Reference 6), are given below in Tables 10 and 11.

Table 10 – Aggressivity Classification for Steel/Iron

Chloride		pH	Resistivity (ohm cm)	Soil Condition A*	Soil Condition B#
In Soil (ppm)	In Water (ppm)				
<5000	<1000	>5.0	>5000	Non-aggressive	Non-aggressive
5000-20000	1000-10000	4.0-5.0	2000-5000	Mild	Non-aggressive
20000-50000	10000-20000	3.0-4.0	1000-2000	Moderate	Mild
>50000	>20000	<3.0	<1000	Severe	Moderate

*Soil Condition A = high permeability soils (e.g. sands and gravels) which are below groundwater
#Soil Condition B = low permeability soils (e.g. silts and clays) and all soils above groundwater

Table 11 – Aggressivity Classification for Concrete

Sulphate expressed as SO_4		pH	Chloride in Water (ppm)	Soil Condition A	Soil Condition B
In Soil (ppm)	In Groundwater (ppm)				
<5000	<1000	>5.5	<6000	Mild	Non-aggressive
5000-10000	1000-3000	4.5-5.5	6000-12000	Moderate	Mild
10000-20000	3000-1000	4.0-4.5	12000-30000	Severe	Moderate
>20000	>10000	<4.0	>30000	Very Severe	Severe

Appropriate Soil Conditions for clayey soils across the site is “Soil Conditions B”. Therefore, based on laboratory test results presented in Table 2 and guidelines on Aggressivity Classifications presented in Tables 11 and 12, the subsurface soils across the site is assessed to be Non-aggressive to steel piles and Non-aggressive to Mildley Aggressive to concrete piles. pH is dominant.

Therefore, if piles are used for the proposed development, we recommend use of piles appropriate for the assessed Aggressivity Classifications.

Excavation Conditions

Proposed development is understood to involve up to about 4.5m to 6.5m deep excavation and possibly some fill placement. Therefore, materials to be excavated are expected to comprise fill, residual soil and bedrock, which is assessed to be Class V and IV shale/siltstone.

It is considered that excavation of soils (including fill and residual soil) and Class V and IV shale/siltstone can be achieved using conventional earthmoving equipment such as excavators and dozers provided slow production rate is acceptable during excavation into Class IV shale/siltstone. We suggest that the selection of rock cutting equipment is based on site access, desired smoothness of the excavated rock surface and acceptable ground vibration during rock excavation.

Ground vibration during rock excavation is generally represented by maximum peak particle velocity. Houses and low rise residential buildings can generally tolerate ground vibration of about 5.0mm/s to 10.0mm/s. We anticipate that excavation into soils as well as Class V and IV shale/siltstone will result in ground vibrations that are likely to be within tolerable limits for stability of existing structures in the vicinity of the site. However, we also recommend a dilapidation survey is undertaken prior to commencement of basement excavation and use of rock saw during excavation into Class IV shale/siltstone to minimise vibration.

Observations during this investigation indicated that the depth to groundwater level is likely to be in excess of 6.5m. Although fluctuations in the level of groundwater or seepage might occur due to variations in rainfall and/or other factors, we do not anticipate proposed basement excavation to encounter significant groundwater inflow. Minor groundwater inflow, if any, could be managed by a conventional sump and pump method.

However, we suggest that a specialist contractor be contacted to carry out site dewatering, if significant groundwater flow is encountered.

Fill Placement

We consider the proposed development works would require some fill placement, if any. The following procedures are recommended for placement of controlled fill, where required:

- Strip existing topsoil and fill and stockpile separately for possible future uses. Excess materials should be disposed off the site.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed residual soils to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill, compacted as described below.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill materials on proof rolled surface of residual soils. The fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). Controlled fill should preferably comprise non-reactive fill (e.g. crushed sandstone) with a maximum particle size not exceeding 75mm, or low plasticity clay. The residual soils and bedrock obtained from excavations within the site may be used in controlled fill after removal of unsuitable materials, if any, crushing to sizes finer than 75mm, proper mixing and moisture conditioning.
- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798-2007 (Reference 7). It should be noted that a Geotechnical Inspection and Testing Authority will generally provide certification on the quality of the entire compacted fill only if Level 1 supervision and testing is carried out.

Batter Slopes and Retaining Structures

Proposed development will involve up to about 4.5m to 6.5m deep basement excavation. Some fill placement might also be required. Cut and fill slopes during and after development works should be battered for stability or retained by engineered retaining structures. Recommend batter slopes for stability of cut and fill slopes are presented in Table 12.

Table 12 – Recommended Batter Slopes for Excavation Faces

Material	Temporary (Horizontal : Vertical)		Permanent (Horizontal : Vertical)	
	Exposed	Protected	Exposed	Protected
Residual Soil/Controlled Fill	1.5:1.0	1.0:1.0	2.5:1.0	2.0:1.0
Shale/Siltstone –Class V/IV	1.0:1.0	0.75:1.0	1.5:1.0	1.0:1.0

Protection of excavation faces can be provided by shotcreting, which may be reinforced. It is also recommended that batter slopes are provided with adequate surface and sub-surface drainage.

It is likely that the basement excavation will extend to site boundaries and therefore adequate space would not be available for battering of cut faces. Therefore, excavation faces would need to be retained by engineered retaining structures. Appropriate retaining structures for the proposed development will comprise contiguous pier walls or soldier pier walls installed prior to commencement of basement excavation or cantilever or gravy wall installed after completion of basement excavation. Earth pressure distribution on such retaining walls may be assumed to be triangular in shape and estimated as follows:

$$p_h = \gamma k H$$

Where,

p_h = Horizontal pressure (kN/m^2)
γ = Total density of materials retained (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)

For design of flexible retaining structures where some lateral movement is acceptable, an active earth pressure coefficient (k_a) is recommended. If it is critical to limit the horizontal deformation of retaining structure, use of an earth pressure coefficient at rest (k_0) is recommended. Recommended earth pressure coefficients for design of retaining structures are presented in the following Table 13.

Table 13 – Recommended Earth Pressure Parameters for Design of Retaining Structures

Retained Material	Unit Weight (kN/m^3)	Active Earth Pressure Coefficient	Passive Earth Pressure (kPa)	At Rest Earth Pressure Coefficient
Residual Soil/Controlled Fill	18.5	0.35	Ignore	0.55
Shale/Siltstone –Class V/IV	20.0	0.20	200	0.30

The above coefficients are based on the assumptions that the ground level behind the retaining structure is horizontal and the retained material is effectively drained. Additional earth pressures resulting from surcharge load (buildings, infrastructures, etc) on retained materials and groundwater pressure, if any, should also be allowed for in design of retaining structures.

If the retaining structures are anchored or strutted the active earth pressure may be assumed to be rectangular and estimated as follows:

$$p_h = 0.3\gamma H$$

Factor 0.3 in above equation may be reduced to 0.2 for the portion of excavation into Class V shale/siltstone.

Floor Slabs and Footings

Material at the base of about 4.5m to 6.5m deep, basement excavation is anticipated to be Class V/IV shale/siltstone bedrock. Therefore, floor slabs for the proposed building may be constructed as ground bearing slabs or suspended slabs supported by footings. We recommend a Modulus of Subgrade Reaction Value of 35.0kPa/mm for design of floor slabs bearing on Class V/IV shale/siltstone.

Loading conditions from the proposed structure are not known at this stage. However, we consider that appropriate footings would comprise shallow footings (pad and strip) founded in shale/siltstone bedrock at the base of 4.5m to 6.5m deep basement excavation, or deep footings (bored piers) socketed into bedrock below the base of excavation. Deep footings might be preferable if footings are to support significant lateral and/or uplift pressures. Shallow footings founded in residual soils and bedrock at a level higher than basement level might also be required for ancillary structures. The recommended allowable bearing pressures for design of shallow and deep footings are presented below in Table 14:

Table 14 – Recommended Allowable Bearing Pressures

Founding Material	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Controlled Fill/Residual Soil	100.0	Ignore
Residual Soil	150.0	Ignore
Shale/Siltstone – Class V	700.0	50.0
Shale/Siltstone – Class IV	1000.0	100.0

Allowable bearing pressures for bedrock shale/siltstone presented in Table 14 are based on the assumption that footings are socketed at least 0.3m into appropriate rock classes. The recommended allowable shaft adhesions against uplift pressures are halves of the shaft adhesions for compressive loads presented in Table 14.

As depths to residual soils and bedrock with the recommended allowable bearing pressures could vary across the site, the founding depths of footings to be constructed will also vary. The depth ranges for residual soils and various rock classes presented in Tables 1 and 6 are measured from existing ground surface at borehole locations and are indicative only. Therefore, an experienced Geotechnical Engineer, on the basis of assessment made during footing excavation or pier hole drilling, should confirm appropriate founding levels during construction.

For footings founded in controlled fill and residual soils, the total settlements of footings under the recommended allowable bearing pressures are estimated to be about 2.0% of the minimum dimension of footings. However, for footings founded in bedrock, total settlements under the recommended allowable bearing pressures are estimated to be about 1.0% of pier diameter or minimum footing dimension. Differential settlements are estimated to be about half the estimated total settlements.

If footings are founded above and within the 1 Horizontal to 1 Vertical line projected from the edge of basement excavation, the recommended allowable bearing pressures presented in Table 14 are not applicable and appropriate allowable bearing pressure will have to be determined by reassessment of materials and rock discontinuities exposed in the excavation face.

Pavement Design

Design of road pavement depends on strength of subgrade, which is usually represented by CBR value and traffic load.

Table 4 indicates that the CBR value for representative samples vary from 3.0% to 4.0%. To allow for likely natural variations in the CBR values of soils across the site, we recommend that the pavement design for the proposed development be based on indicative CBR value of 3.0%.

Austroads (Reference 8) recommends that the flexible pavement for local access roads with bus are designed for design traffic load of 1.5 x 10^5 Equivalent Standard Axles (ESA). It is our assessments that this traffic load is appropriate for the proposed development.

For recommended indicative design subgrade CBR value of 3.0% and traffic loading of 1.5 x 10^5 ESA the recommended flexible pavement design in accordance with Austroads (Reference 8) is presented in the following Table 15:

Table 15 – Recommended Pavement Design

Pavement Materials	Thickness
Asphaltic Concrete	50mm
Two coat hot bitumen seal	
Basecourse Material (DGB20)	150mm
Sub-base Material (DGS40)	210mm

Recommended pavement thicknesses presented in Table 15 are valid only if the subgrade and pavement materials are compacted to the following Minimum Dry Density Ratios.

Basecourse	98% Modified
Sub-basecourse	98% Modified
Subgrade	100% Standard

The pavement design assumes provision of adequate surface and sub-surface drainage of the pavement and adjacent areas.

It should be noted that the pavement design will change of assumed traffic is not appropriate for the proposed development works.

Acid Sulphate Soil Assessment

The Acid Sulphate Management Advisory Committee, New South Wales (Reference 9), recommends that assessment of acid sulphate soils and/or potentially acid sulphate soils at a site is carried out in stages, as follows:

Step 1 – Check the Acid Sulphate Soils Map.
Step 2 – Check if the area meets the geomorphic or site criteria.
Step 3 – Analyse soil and water indicators.
Step 4 – Chemical analysis to confirm Acid Sulphate Soil and action level.

Acid Sulphate Soil Risk Map (Edition 2, 1:25,000) of Botany Bay prepared by Department of Land and Water Conservation indicates that there are no known occurrence of acid sulphate soils at the site.

The sub-surface profile across the site comprises a sequence of topsoil/fill and residual soils to depths of about 1.3m to 2.7m from existing ground surface. The ground surface elevation across the site is more than 20.0m AHD. Therefore, geomorphology and site conditions indicate acid sulphate soils unlikely to be encountered across the site.

No soil and water indicators of acid sulphate soils were observed. Depth to groundwater level is anticipated to be more than 6.5m from existing ground surface. Therefore, even if level of groundwater might fluctuate due to variations in rainfall and/or other factors not evident during drilling, it is unlikely that proposed development works will lower the groundwater level to expose the acid sulphate or potentially acid sulphate soils to atmosphere.

The above assessments based on review of available information indicate acid sulphate or potentially acid sulphate soils are unlikely to be encountered across the site.

Representative soil samples obtained from various depths were tested for acid sulphate or potentially acid sulphate soils. The laboratory test results summarised in Table 3 indicate the following:

- The pH_{kcl} (field pH) values are in range of 3.8 to 5.2, indicating actual acid sulphate soils are absent at the site, but does not give an indication whether potential acid sulphate soils are present or not.
- The pH_{ox} values (pH after oxidation) of samples are in range of 3.8 to 4.5. The pH_{ox} values of two samples out of three samples are higher than the pH_{kcl} values, indicating oxidation of these soil samples is unlikely to produce any acid. However, one samples shows drop is pH after oxidation indicating possibility that some soil sample may produce acid during oxidation, an indication of acid sulphate soils.

Acid sulphate soils are a problem because they produce significant acid (sulphuric acid) by oxidation when exposed to oxygen, which might occur during excavation or disturbance of soils containing iron sulphides/oxidisable sulphur. Lowering the groundwater level might also encourage oxidation. The New South Wales Acid Sulphate Soils Management Advisory Committee (Reference 9) recommends "Action Criteria" (Table 16) based on results of acid sulphate soils analysis for three broad texture categories. Works in soils that exceed these "Action Criteria" must be carried out in accordance with an approved Acid Sulphate Soils Management Plan (ASSMP).

Table 16 – Action Criteria for Acid Sulphate Soils

Type of Material		**Action Criteria 1-1000 tonnes of soil is disturbed**		**Action Criteria More than 1000 tonnes of soil is disturbed**	
Texture Range	**Clay Content <0.002mm** (%)	**Sulphur Trail** % S oxidisable (S_{TOS} or S_{POS})	**Acid Trail** mol H^+/tonne (TPA or TSA)	**Sulphur Trail** % S oxidisable (S_{TOS} or S_{POS})	**Acid Trail** mol H^+/tonne (TPA or TSA)
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5-40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.10	62	0.03	18

The borehole logs indicate soils likely to be disturbed or excavated during proposed development are predominantly silty clay, assessed to belong to "Fine Texture".

Laboratory test results presented in Table 3 shows that the Oxidisable Sulphur (S_{POS}) and Chromium Reducible Sulphur (S_{cr}) for all samples are less than 0.03%. Therefore, based in Sulphur Trial "Action Criterial" soils likely to be disturbed or excavated during proposed development are unlikely to be acid sulphate soils.

As discussed above, pH_{ox} of two soil samples out of three samples are higher than pH_{kcl} indicating these samples do not produce acid during oxidation and therefore are not acid sulphate soils. The third sample with pH_{ox} lower than pH_{kcl} indicating production of some acid during oxidation shows Total Potential Acidity (TPA), Total Actual Acidity (TAA) and Total Sulphidic Acidity (TSA) of less than 18.0 H^+/tonne. Therefore, based in Acid Trial "Action Criterial" soils likely to be disturbed or excavated during proposed development are unlikely to be acid sulphate soils.

Therefore, even if volume of soils to be disturbed or excavated during the proposed development works is more than 1000 tonnes, the Action Criteria for both Sulphur Trail and Acid Trail presented in Table 16 show that the excavations and disturbance of soils during the proposed development works may be carried out without an approved "Acid Sulphate Soils Management Plan".

General

The geotechnical investigation indicates the following:

- The sub-surface profile across the site comprises a sequence of topsoil/fill and residual soils underlain by bedrock. The depth to bedrock across the site is likely to vary from about 1.3m to 2.7m from existing ground surface.
- The depth to groundwater across the site is deeper than the proposed base of excavation under normal conditions.
- Soils likely to be disturbed and/or excavated during proposed development works are: (1) non-saline; (2) Non-aggressive to steel piles; (3) Non-aggressive to Mildly Aggressive to concrete piles; and (4) not acid sulphate of potential acid sulphate soils.

Therefore, geotechnical conditions across 59-67 Karne Street North, Narwee, do not impose any limitation on the proposed development and that means geotechnical conditions are suitable for proposed development, provided excavation and fill placement and design of retaining structures, floor slabs and footings of building and pavement are carried out in accordance with recommendations provided in this report. The excavation and disturbance of soils can be carried out without Saline Soil Management Plan (SSMP) and Acid Sulphate Soil Management Plan (ASSMP).

Assessments and recommendations presented in this report are based on site observation and information from only eight boreholes and laboratory tests on representative samples. Although we believe that the sub-surface profile presented in this report is indicative of the general profile across the site, it is possible that the sub-surface profile across the site could differ from that encountered in the boreholes. Likewise, comments on depth to groundwater level are based on observation during a short period of time. We recommend that this company is contacted for further advice if actual site conditions and depth to groundwater level encountered during basement excavation differ from those presented in this report.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

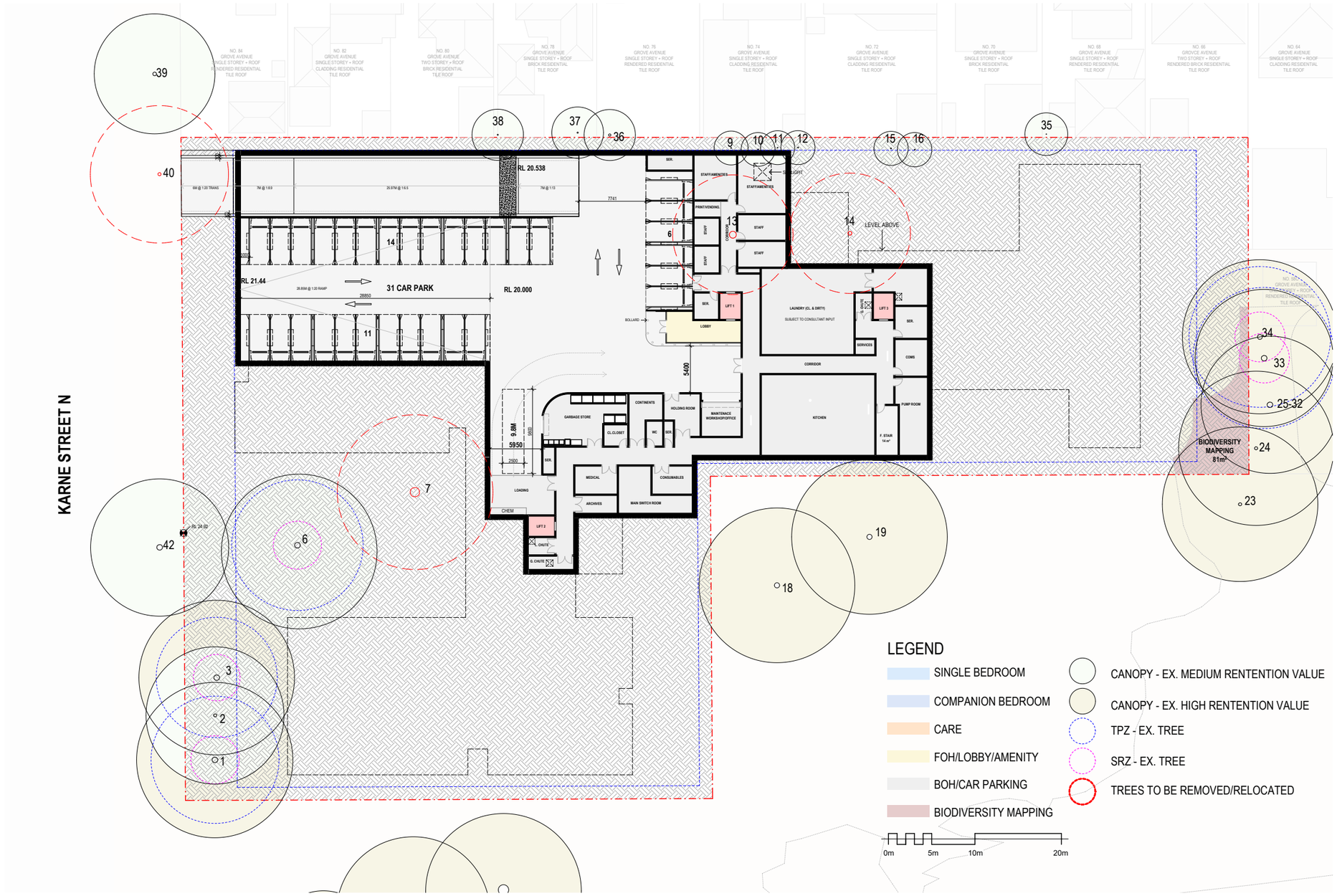
INDRA JWORCHAN
MIEAust CPEng NER APEC Engineer IntPE(Aust)
Principal Geotechnical Engineer

Attached
Outline of Proposed Basement Excavation
Drawing No 20219/1-AA1 Borehole Location Plan
Engineering Borehole Logs & Explanatory Notes
Laboratory Test Results

References

1. Australian Standard AS1726-2017, Geotechnical Site Investigation 2017.
2. Geotechnique Pty Ltd, Geotechnical Investigation, Proposed Aged care Facility, 59-65 Karne Street North, Narwee, Report No 13977/3-AA, 31 March 2016.
3. Pells, P J N, Mostyn, E, Bertuzzi, B. and Wong, P. K, Classification of Sandstone and Shale in the Sydney Region: A Forty Years Review, Australian Geomechanics Journal, Vol 54, No 2, June 2019.
4. Lillicrap, A and McGhie, S., Site Investigation for Urban Salinity, Department of Land and Water Conservation, 2002.
5. Australian Standard AS2870-2011, Residential Slabs and Footings, 2011.
6. Australian Standard AS2159-2009, Piling – Design and Installation, 2009.
7. Australian Standard AS3798-2007, Guidelines on Earthworks for Commercial and Residential Developments, 2007.
8. Austroads, Pavement Design for Light Traffic: A supplement to Austroads Pavement Design Guide, AP-T36/06, 2006.
9. New South Wales, Acid sulphate Soil Management Advisory Committee, 1988 – Acid sulphate Soil Manual.

BASEMENT



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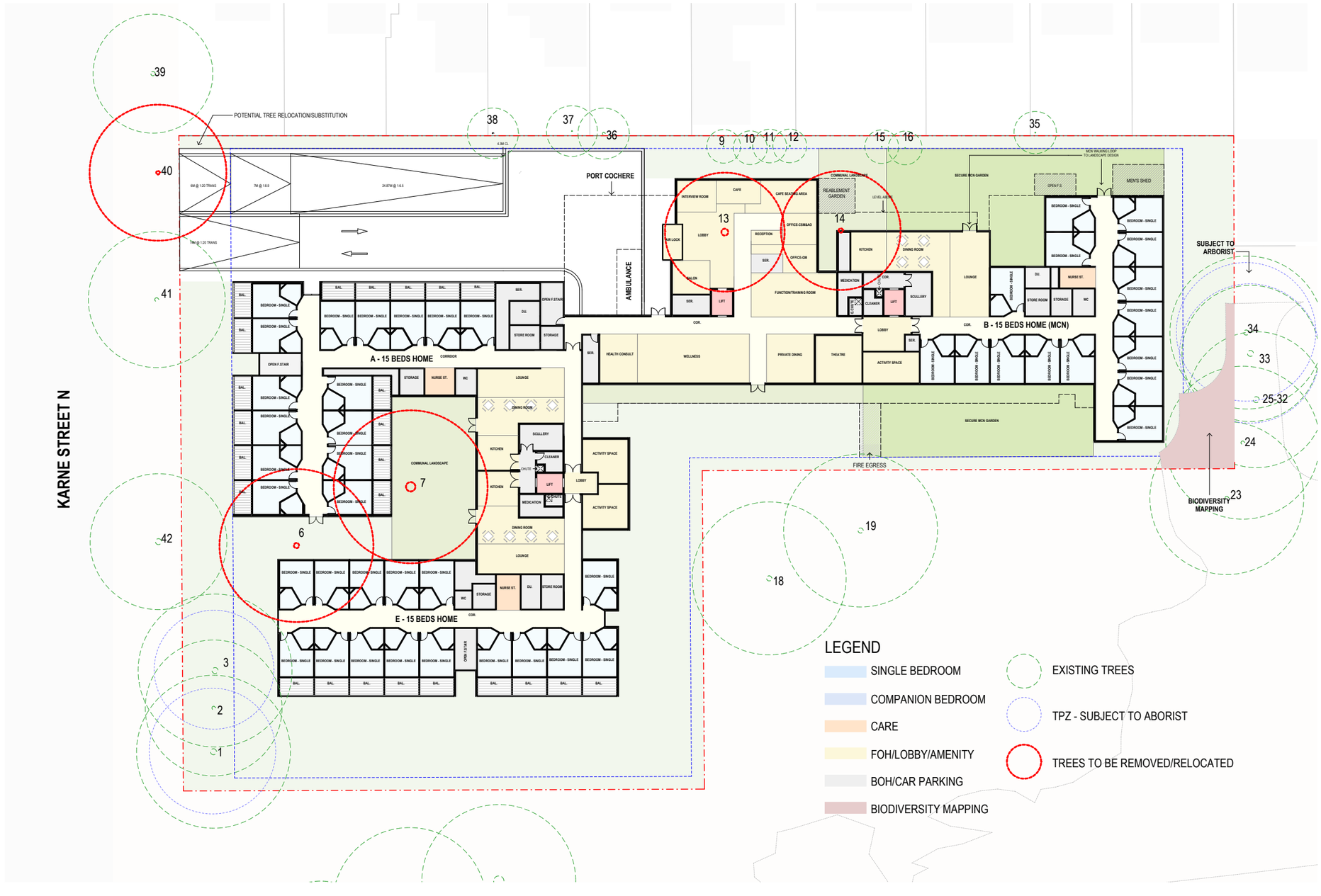
Narwee Parklands Care Community
For: Opal HealthCare

GROUPGSA

GROUND FLOOR



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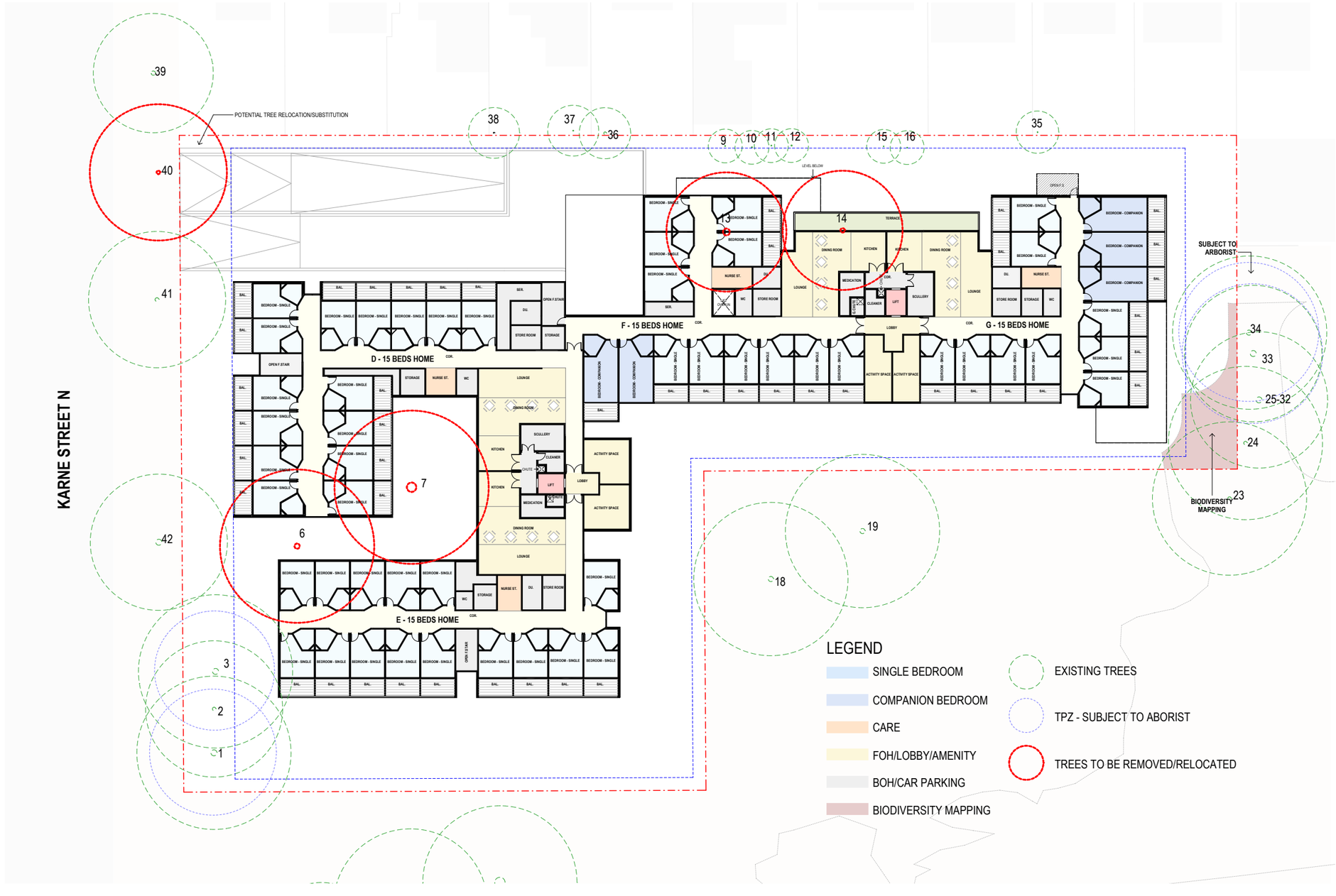
Narwee Parklands Care Community
For: Opal HealthCare

GROUPGSA

LEVEL 1 AND 2



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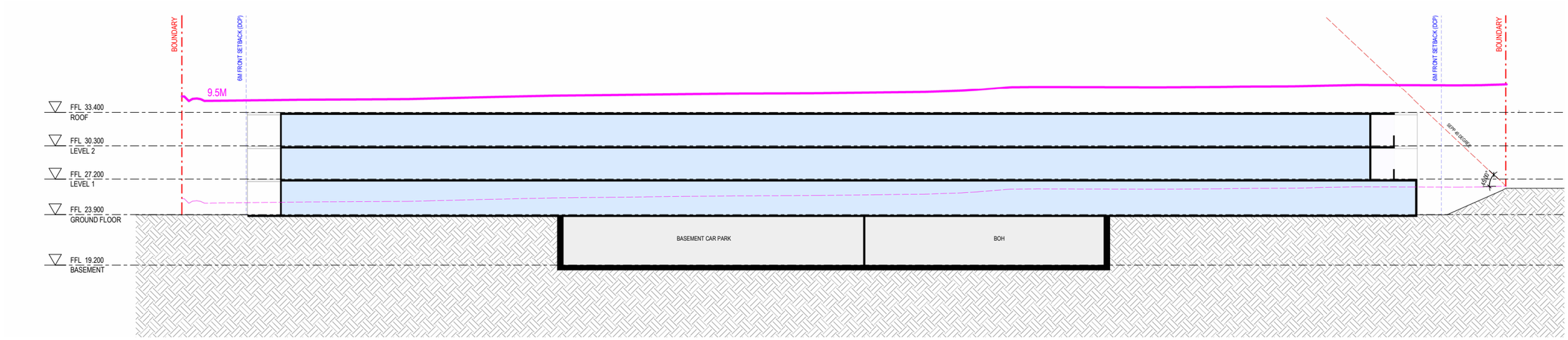
Narwee Parklands Care Community
For: Opal HealthCare

GROUPGSA

CONCEPT SECTIONS



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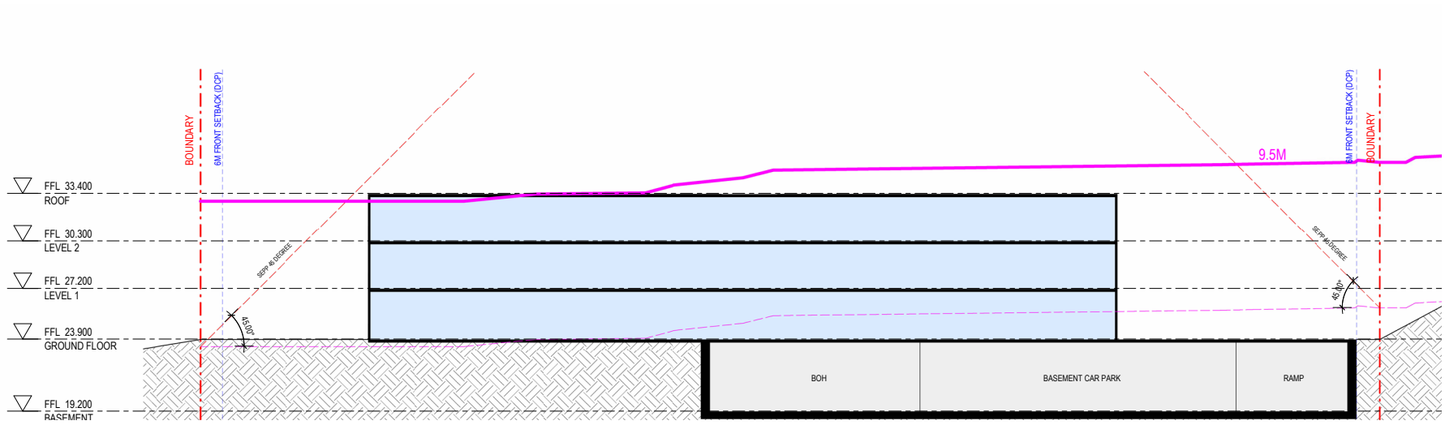

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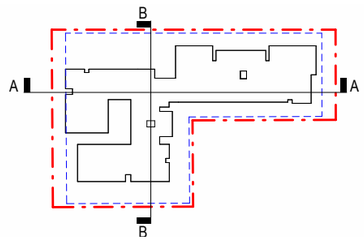

Narwee Parklands Care Community
For: Opal HealthCare

N

LEGEND

- Borehole
- Borehole (March 2017)

Imagery ©2022 NearMap.com

0 10 20 30 40 50m

Scale 1:1000

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NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

Cyre Projects Pty Limited
Proposed Aged Care Facility
59-67 Karne Street North
Narwee

Borehole Locations

Drawing No: 20219/1-AA1
Job No: 20219/1
Drawn By: MH
Date: 5 July 2022
Checked By: KB/IJ

File No: 20219-1
Layers: 0, AA1

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engineering log - borehole

Client : Cyre Projects Pty Limited
Project : Proposed Aged Care Facility
Location : 59-67 Karne Street North, Narwee

Job No. : 20219/1
Borehole No. : BH101
Date : 29/06/2022
Logged/Checked by: KB/IJ

drill model and mounting : Edson 100 **slope :** **deg.** **R.L. surface :**

hole diameter : **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
AD/T	DRY					0			CONCRETE SLAB				
									FILL: Silty Sandy Clay, low to medium plasticity, dark grey brown, fine grained sand, traces of fine to medium sub-rounded gravel and rootlets				Fill (Uncontrolled)
						0.5			Silty CLAY, medium plasticity, pale grey and pale brown mottled red brown (iron stain), traces of fine to medium angular ironstone gravel and rootlets	M<PL	F-St		Natural (Residual Soil)
				DS	N=5 3,2,3	1			From 1.2m, grading into extremely weathered material				
				DS	N= 12/HB- 130	1.5			SHALE/SILTSTONE, pale brown to pale grey, extremely to highly weathered, very low strength				Bedrock
						2.5			Augering terminated at 2.5m Continue as NMLC				
						3							
						3.5							
						4							
						4.5							

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engineering log
cored borehole

Client : Cyre Projects Pty Limited
Project : Proposed Aged Care Facility
Location : 59-67 Karne Street North, Narwee

Job No. : 20219/1
Borehole No. : BH101
Date : 29/06/2022
Logged/Checked by : KB/IJ

drill model and mounting : Edson 100m **slope :** **deg.** **R.L. surface :**
core size: NMLC **bearing :** **deg.** **datum :**

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	DEFECT DETAILS defect spacing (mm) 2000 1000 500 300 100 50	DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		2		Augering terminated at 2.5m					
		2.5		SHALE/SILTSTONE, pale grey and brown with iron staining, interbedded lamination, thinly bedded	HW	L			CS (2.50-2.56): 60mm CS (2.64-2.68): 40mm JT (2.97): PR, SM, SN Fe (75-90)° XWS (3.00-3.09): 90mm clay JT (3.09-3.20): PR, SM, CL, SN, Fe (45-60)° per 10mm (joint group) JT (3.21) PR, SM, SN, Fe (75-90)° XWS (3.24-3.27): 30mm clay JT (3.32): PR, SM, SN, Fe (15-30)° JT (3.48): PR, SM, CL (75-90)° JT (3.68): PR, SM, SN, Fe (75-90)° JT (3.81): PR, SM, SN Fe (75-90)° XWS (3.84-3.86): 20mm clay JT (3.88): UN, SM, CL, (45-60)° JT (4.08): PR, CL, Fe (45-60)° JT (4.24): PR, CL, Fe (45-60)° XWZ (4.32-4.42): 100mm shaley clay XWS (4.63-4.65): 20mm clay
		3							
		3.5							
		4							
		4.5			MW	L-M			
		5							
		5.5		Borehole BH101 terminated at 5.3m					
		6							
		6.5							

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Job No 20219/1-AA BH101 Started Coring at 2.5m

BH101 terminated at 5.3m

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engineering log - borehole

Client : Cyre Projects Pty Limited
Project : Proposed Aged Care Facility
Location : 59-67 Karne Street North, Narwee

Job No. : 20219/1
Borehole No. : BH102
Date : 29/06/2022
Logged/Checked by: KB/IJ

drill model and mounting : Edson 100 **slope :** **deg.** **R.L. surface :**

hole diameter : **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
AD/T	DRY					0			TOPSOIL: Silty Clay, low to medium plasticity, brown and grey, traces of fine to medium sub-rounded gravel and rootlets	M>PL			TOPSOIL
		DS							FILL: Silty Clay, medium plasticity, red brown, with fine to medium sub-angular gravel and traces of rootlets	M≥PL			Fill (Possible) VENM
				DS	N=8 4,4,4	0.5				M<PL			
						1			Silty CLAY, medium to high plasticity, pale grey with red brown, traces of rootlets and fine to medium sub-rounded gravel (shale fragments) From 1.2m, grading into extremely weathered	M<PL	St		Residual Soil
						1.5			SHALE, pale brown, extremely weathered material, very low strength, low resistance to augering				Bedrock (extremely weathered material)
						2							
						2.5			From 2.8m, medium resistance to augering, distinctly weathered, very low to low strength				Increase in augering resistance
						3							
						3.5			Augering terminated at 3.1m Continue as NMLC				
						4							
						4.5							

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engineering log
cored borehole

Client : Cyre Projects Pty Limited
Project : Proposed Aged Care Facility
Location : 59-67 Karne Street North, Narwee

Job No. : 20219/1
Borehole No. : BH102
Date : 29/06/2022
Logged/Checked by : KB/IJ

drill model and mounting : Edson 100m **slope :** **deg.** **R.L. surface :**
core size: NMLC **bearing :** **deg.** **datum :**

barrel lift	water loss/level	depth of R.L. in meters	graphic log	CORE DESCRIPTION rock type, grain characteristics, colour, structure, minor components.	weathering	strength	point load index strength $I_S(50)$ EL VL L M H VH	defect spacing (mm) 2000 1000 500 300 100 50	DEFECT DETAILS DESCRIPTION type, inclination, thickness, planarity, roughness, coating. Specific / General
		3		Augering terminated at 3.1m					
		3.5		SHALE/SILTSTONE, dark grey with iron stain, laminite, very thinly to thinly bedded	DW	L			JT (3.19): PR, SM, SN, Fe (45-60)° XWS (3.40-3.41): 10mm clay JT (3.45)L PR, SM, CL, SN (45-60)° JT (3.62): PR, SM, SN, Fe (60-75)° JT (3.67): PR, SM, SN, Fe (60-75)°
		4				L-M			JT (3.75): UN, SM, VNR clay (75-90)° CS (4.0-4.02): 20mm
		4.5							JT (4.10-4.15): PR, SM, CL (15-30)° x 3 CS (4.18-4.20): 20mm JT (4.33): UN, SM, SN, Fe
		5		Borehole BH102 terminated at 5.0m TD reached					JT (4.74): PR, SM, CL, Fe JT (4.91): UN, SM, SN, Fe
		5.5							
		6							
		6.5							
		7							
		7.5							

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Job No 20219/1-AA BH102 Started Coring at 3.1m

4.0m

Started at 3.1m

5.0m

BH102 terminated at 5.0m

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Log Symbols & Abbreviations (Non-cored Borehole Log)

Log Column	Symbol/Value	Description
Drilling Method	V-bit TC-bit RR DB BB	Hardened steel 'V' shaped bit attached to auger Tungsten Carbide bit attached to auger Tricone (Rock Roller) bit Drag bit Blade bit
Groundwater	Dry  	Groundwater not encountered to the drilled or auger refusal depth Groundwater level at depths shown on log Groundwater seepage at depths shown on log
Environment Sample	GP G P	Glass bottle and plastic bag sample over depths shown on log Glass bottle sample over depths shown on log Plastic bag sample over depths shown on log
PID Reading	100	PID reading in ppm
Geotechnical Sample	DS DB U_{50}	Disturbed Small bag sample over depths shown on log Disturbed Bulk sample over depths shown on log Undisturbed 50mm tube sample over depths shown on log
Field Test	N=10 3,5,5 N=R 10,15/100	Standard Penetration Test (SPT) 'N' value. Individual numbers indicate blows per 150mm penetration. 'R' represents refusal to penetration in hard/very dense soils or in cobbles or boulders. The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal
	DCP/PSP: 5 6 R/10	Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. 'R/10' represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.
Classification	GP GW GM GC SP SW SM SC ML MI MH CL CI CH	Poorly Graded GRAVEL Well graded GRAVEL Silty GRAVEL Clayey GRAVEL Poorly graded SAND Well graded SAND Silty SAND Clayey SAND SILT / Sandy SILT / clayey SILT, low plasticity SILT / Sandy SILT / clayey SILT, medium plasticity SILT / Sandy SILT / clayey SILT, high plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity
Moisture Condition Cohesive soils Cohesionless soils	 M<PL M=PL M>PL D M W	 Moisture content less than Plastic Limit Moisture content equal to Plastic Limit Moisture content to be greater than Plastic Limit Dry - Runs freely through hand Moist - Tends to cohere Wet - Tends to cohere
Consistency Cohesive soils	 VS S F St VSt H	**Term** / **Undrained shear strength, C_u (kPa)** / **Hand Penetrometer (Qu)** Very Soft / ≤12 / <25 Soft / >12 & ≤25 / 25 – 50 Firm / >25 & ≤50 / 50 – 100 Stiff / >50 & ≤100 / 100 – 200 Very Stiff / >100 & ≤200 / 200 – 400 Hard / >200 / >400
Density Index Cohesionless soils	 VL L M D VD	**Term** / **Density Index, I_D (%)** / **SPT 'N' (blows/300mm)** Very Loose / ≤15 / ≤5 Loose / >15 & ≤35 / >5 & ≤10 Medium Dense / >35 & ≤65 / >10 & ≤30 Dense / >65 & ≤85 / >30 & ≤50 Very Dense / >85 / >50
Hand Penetrometer	100 200	Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log
Remarks	 Residual Alluvium Colluvial Aeolian Marine	Geological origin of soils Residual soils above bedrock River deposited Alluvial soils Gravity deposited Colluvial soils Wind deposited Aeolian soils Marine Soils

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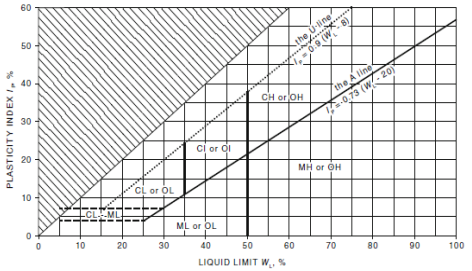
AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification				
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63										
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 0.075	SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**		More than 35% passing 0.075mm	Below 'A' line			
					None to low	Slow to rapid	Low						
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				



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Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	Symbol / Abbreviation	Description	
Core Size		Nominal Core Size (mm)	
	NQ	47	
	NMLC	52	
	HQ	63	
Water Loss	◀	Complete water loss	
	◁	Partial water loss	
Weathering (AS1726:2017)	RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported
	XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
	HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	MW	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock
	SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock
	FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'	
Strength (AS1726:2017)		**Term**	**Point Load Strength Index (I_{s50}, MPa)**
	VL	Very Low	≥0.03 ≤0.1
	L	Low	>0.1 ≤0.3
	M	Medium	>0.3 ≤1
	H	High	>1 ≤3
	VH	Very High	>3 ≤10
	EH	Extremely High	>10
Defect Spacing		**Description**	**Spacing (mm)**
		Extremely closely spaced	<20
		Very closely spaced	20 to 60
		Closely spaced	60 to 200
		Medium spaced	200 to 600
		Widely spaced	600 to 2000
		Very widely spaced	2000 to 6000
		Extremely widely spaced	>6000
Defect Description (AS1726:2017) Type			
	Pt	Parting	
	Jo	Joint	
	Sh	Sheared Surface	
	Sz	Sheared Zone	
	Ss	Sheared Seam	
	Cs	Crushed Seam	
	Is	Infilled Seam	
	Ews	Extremely Weathered Seam	
Macro-surface geometry	St	Stepped	
	Cu	Curved	
	Un	Undulating	
	Ir	Irregular	
	Pl	Planar	
Micro-surface geometry	Vro	Very Rough	
	Ro	Rough	
	Sm	Smooth	
	Po	Polished	
	Sl	Slickensided	
Coating or infilling	cn	clean	
	sn	stained	
	vn	veneer	
	cg	coating	

GEOTECHNIQUE PTY LTD

AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)							
More than 20	20	Grain Size Description			At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix	LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix	SALINE ROCKS
	2			Breccia Irregular rock fragments in a finer matrix				Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	Halite Anhydrite
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals		Calcarenite		Cemented volcanic ash TUFF	Gypsum
	0.2		Medium	Quartzite Quartz grains and siliceous cement					
	0.06		Fine	Arkose Many feldspar grains Greywacke Many rock chips					
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone					COAL LIGNITE
				Granular cemented – except amorphous rocks					
				SILICEOUS	CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid					

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)		Rocks with massive structure and crystalline texture (mostly igneous)						Grain size (mm)
Grain size description			Grain size description	Pegmatite			Pyrosenite	More than 20
		MARBLE						20
	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands	QUARTZITE		GRANITE	Diorite	GABBRO	Peridorite	6
COARSE		Granulite	COARSE	These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite				
	Migmatite Irregularly foliated: mixed schists and gneisses	HORNFELS						2
	SCHIST Well developed undulose foliation; generally much mica	Amphibolite		Micorgranite	Microdiorite			0.6
MEDIUM		Serpentine	MEDIUM	These rocks are sometimes phorphyritic and are then described as porphyries		Dolerite		0.2
								0.06
	PHYLLITE Slightly undulose foliation; sometimes 'spotted'			RHYOLITE	ANDESITE			0.002
FINE	SLATE Well developed plane cleavage (foliation)		FINE	These rocks are sometimes phorphyritic and are then described as porphyries		BASALT		Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystalline
CRYSTALLINE				Pale<----------->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

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Order Number	(Not specified)
Samples	3

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SGS Reference	**SE233797 R0**
Date Received	1/7/2022
Date Reported	7/7/2022

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SPOCAS and CRS subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146. Report No. CE160279.

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

Conductivity and TDS by Calculation - Soil [AN106] Tested: 6/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	**34**	**50**	**84**

pH in soil (1:2) [AN101] Tested: 6/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
pH (1:2)	pH Units	-	**4.4**	**5.7**	**4.6**

Conductivity (1:2) in soil [AN106] Tested: 6/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
Conductivity (1:2) @25 C*	µS/cm	1	**52**	**70**	**120**
Resistivity (1:2)*	ohm cm	-	**19000**	**14000**	**8400**

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography [AN245] Tested: 6/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
Chloride	mg/kg	0.25	**5.9**	**3.3**	**16**
Sulfate	mg/kg	0.5	**57**	**130**	**82**

Moisture Content [AN002] Tested: 6/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
% Moisture	%w/w	1	**25.7**	**25.5**	**20.8**

TAA (Titratable Actual Acidity) [AN219] Tested: 7/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
pH KCl*	pH Units	-	**3.8**	**5.2**	**3.8**
Titratable Actual Acidity	kg H2SO4/T	0.25	**6.0**	**0.86**	**6.2**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**122**	**17**	**127**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.20**	**0.03**	**0.20**
Sulphur (SKCl)	%w/w	0.005	<0.005	<0.005	**0.015**
Calcium (CaKCl)	%w/w	0.005	**0.011**	**0.12**	**0.007**
Magnesium (MgKCl)	%w/w	0.005	**0.045**	**0.026**	**0.049**

TPA (Titratable Peroxide Acidity) [AN218] Tested: 7/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
Peroxide pH (pH Ox)	pH Units	-	**4.4**	**3.8**	**4.5**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25	**6.9**	**0.74**	**7.5**
TPA as moles H+/tonne	moles H+/T	5	**140**	**15**	**152**
TPA as S % W/W	%w/w S	0.01	**0.22**	**0.02**	**0.24**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5	**17**	<5	**25**
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25	**0.86**	<0.25	**1.2**
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01	**0.03**	<0.01	**0.04**
ANCE as % $CaCO_3$	% CaCO3	0.01	<0.01	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5	<5	<5	<5
ANCE as S % W/W	%w/w S	0.01	<0.01	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)*	%w/w	0.005	**0.009**	**0.008**	**0.011**
Peroxide Oxidisable Sulphur as moles H+/tonne*	moles H+/T	5	**6**	<5	**7**
Sulphur (Sp)	%w/w	0.005	**0.013**	**0.011**	**0.026**
Calcium (Cap)	%w/w	0.005	**0.013**	**0.14**	**0.009**
Reacted Calcium (CaA)*	%w/w	0.005	<0.005	**0.012**	<0.005
Reacted Calcium (CaA)*	moles H+/T	5	<5	**6**	<5
Magnesium (Mgp)	%w/w	0.005	**0.048**	**0.028**	**0.051**
Reacted Magnesium (MgA)*	%w/w	0.005	<0.005	<0.005	<0.005
Reacted Magnesium (MgA)*	moles H+/T	5	<5	<5	<5
Net Acid Soluble Sulphur as % w/w*	%w/w	0.005	**0.006**	-	<0.005
Net Acid Soluble Sulphur as moles H+/tonne*	moles H+/T	5	<5	-	<5

SPOCAS Net Acidity Calculations [AN220] Tested: 7/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
s-Net Acidity	%w/w S	0.005	**0.21**	**0.036**	**0.22**
a-Net Acidity	moles H+/T	5	**130**	**22**	**140**
Liming Rate*	kg CaCO3/T	0.1	**9.8**	**1.7**	**10**
Verification s-Net Acidity*	%w/w S	-20	**0.00**	**0.00**	**0.00**
a-Net Acidity without ANCE*	moles H+/T	5	**130**	**22**	**140**
Liming Rate without ANCE*	kg CaCO3/T	0.1	**9.8**	**1.7**	**10**

Chromium Reducible Sulfur (CRS) [AN217] Tested: 7/7/2022

PARAMETER	UOM	LOR	BH101 SOIL 0.5-0.95 29/6/2022 SE233797.001	BH102 SOIL 0.3-0.45 29/6/2022 SE233797.002	BH102 SOIL 0.5-0.95 29/6/2022 SE233797.003
Chromium Reducible Sulfur (Scr)	%	0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulfur (Scr)	moles H+/T	5	<5	<5	<5

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:2 and the pH determined and reported on the extract after 1 hour extraction (pH 1:2) or after 1 hour extraction and overnight aging (pH (1:2) aged). Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN106	Resistivity of the extract is reported on the extract basis and is the reciprocal of conductivity. Salinity and TDS can be calculated from the extract conductivity and is reported back to the soil basis.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulfide (H2S) which is collected and titrated with iodine (I2(aq)) to measure SCR.
AN218	Soil samples are subjected to extreme oxidising conditions using hydrogen peroxide. Continuous application of heat and peroxide ensure all sulfide is converted to sulfuric acid. Excess peroxide is broken down by a copper catalyst prior to titration for acidity. Calcium, magnesium, and sulfur are determined by ICP-OES. Also included is a carbonate modification step which, depending on pH after the initial oxidation, gives a measure of ANC.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulfur are determined by ICP-AES.
AN220	SPOCAS Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.
AN245	Anions by Ion Chromatography: A water sample or extract is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-qb/environment-health-and-safety.

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STATEMENT OF QA/QC PERFORMANCE

SE233797 R0

CLIENT DETAILS

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Order Number	(Not specified)
Samples	3

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SGS Reference	**SE233797 R0**
Date Received	01 Jul 2022
Date Reported	07 Jul 2022

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Analysis Date	Conductivity and TDS by Calculation - Soil	3 items

SAMPLE SUMMARY

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 Soil
Date documentation received	1/7/2022	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	7.2°C	Sufficient sample for analysis	Yes
Turnaround time requested	Standard		

HOLDING TIME SUMMARY

SE233797 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH101	SE233797.001	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022
BH102	SE233797.002	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022
BH102	SE233797.003	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH101	SE233797.001	LB252831	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022†
BH102	SE233797.002	LB252831	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022†
BH102	SE233797.003	LB252831	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022†

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH101	SE233797.001	LB252827	29 Jun 2022	01 Jul 2022	13 Jul 2022	06 Jul 2022	11 Jul 2022	07 Jul 2022
BH102	SE233797.002	LB252827	29 Jun 2022	01 Jul 2022	13 Jul 2022	06 Jul 2022	11 Jul 2022	07 Jul 2022
BH102	SE233797.003	LB252827	29 Jun 2022	01 Jul 2022	13 Jul 2022	06 Jul 2022	11 Jul 2022	07 Jul 2022

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH101	SE233797.001	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022	06 Jul 2022
BH102	SE233797.002	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022	06 Jul 2022
BH102	SE233797.003	LB252832	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	07 Jul 2022	06 Jul 2022

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH101	SE233797.001	LB252833	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	03 Aug 2022	07 Jul 2022
BH102	SE233797.002	LB252833	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	03 Aug 2022	07 Jul 2022
BH102	SE233797.003	LB252833	29 Jun 2022	01 Jul 2022	06 Jul 2022	06 Jul 2022	03 Aug 2022	07 Jul 2022

SURROGATES

SE233797 R0

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB252832.001	Conductivity (1:2) @25 C*	µS/cm	1	<1

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB252831.001	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	0.44

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB252833.001	Chloride	mg/kg	0.25	<0.25
	Sulfate	mg/kg	0.5	<0.5

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE233797.003	LB252832.007	Conductivity (1:2) @25 C*	µS/cm	1	120	120	32	1
		Resistivity (1:2)*	ohm cm	-	8400	8300	30	1

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE233859.002	LB252831.014	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	57	54	34	5

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE233859.002	LB252827.006	% Moisture	%w/w	1	16.8	15.2	36	10

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE233797.003	LB252832.007	pH (1:2)	pH Units	-	4.6	4.5	32	0

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE233731.007	LB252833.015	Chloride	mg/kg	0.25	56	52	30	8
		Sulfate	mg/kg	0.5	110	100	32	8
SE233797.003	LB252833.014	Chloride	mg/kg	0.25	16	16	32	2
		Sulfate	mg/kg	0.5	82	87	32	6

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity (1:2) in soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB252832.002	Conductivity (1:2) @25 C*	µS/cm	1	290	303	70 - 130	95

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB252831.002	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	NA	303	85 - 115	96

pH in soil (1:2)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB252832.003	pH (1:2)	pH Units	-	7.4	7.415	98 - 102	99

Soluble Anions in Soil from 1:2 DI Extract by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB252833.002	Chloride	mg/kg	0.25	37	40	70 - 130	93
	Sulfate	mg/kg	0.5	37	40	70 - 130	92

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

SE233797 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161
email: info@geotech.com.au

Page

TO:	**SGS ENVIRONMENTAL SERVICES UNIT 16 33 MADDOX STREET ALEXANDRIA NSW 2015**	**Sampling By:**	KB	**Job No:**	**20219/1**
				Project:	**Proposed Aged Care Facility**
PH:	**02 8594 0400**	**FAX:**	**02 8594 0499**		
ATTN:	**Ms Emily Yin**	**Project Manager:**	IJ	**Location:**	**24-26 Avon Road, Dee Why**

Sampling details				Results required by:									
Location	**Depth**	**Soil**	**Water**	**sPOCAS**	**CRS**	**EC (1:5)**	**Aggressive**					**Notes**	**Keep Sample**
BH101	0.5-0.95	DSP		✓	✓	✓	✓					sPOCAS test includes	✓
BH102	0.3-0.45	DSP		✓	✓	✓	✓					pH(kcl), pH(ox), TPA, TAA, TSA, Sox	✓
BH102	0.5-0.95	DSP		✓	✓	✓	✓						✓
												CRS=Chromium Reducible Sulphur	
												EC(1:5) = Soil Water Ratio of 1 to 5	
												Aggressive Test includes	
												pH, SO4, Cl, Resistivity	

SGS EHS Sydney COC
SE233797

Full Excel Output File Please

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	
Indra Jworchan		30-Jun-22	MIBNS QUT	1-7-22 10:30	

Legend:

WG	USG	Undisturbed soil sample (glass	DSP	Disturbed soil sample (small plastic bag)	* Purge & Trap
WP	DSG	Disturbed soil sample (glass ja	✓	Test required	# Geotechnique Screen

Form No 4.7F2-5 SGS

SAMPLE RECEIPT ADVICE

SE233797

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	indra.jworchan@geotech.com.au
Project	**20219/1 67 Karne Street, Narawee**
Order Number	**20219/1**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Fri 1/7/2022
Report Due	Fri 8/7/2022
SGS Reference	**SE233797**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Friday 1/7/2022. Results are expected to be ready by COB Friday 8/7/2022. Please quote SGS reference SE233797 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 Soil
Date documentation received	1/7/2022	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	7.2°C	Sufficient sample for analysis	Yes
Turnaround time requested	Standard		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SPOCAS and CRS subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146.
Extra sample BH101 1.5-1.63 received.

SAMPLE RECEIPT ADVICE

SE233797

CLIENT DETAILS

Client Geotechnique

Project 20219/1 67 Karne Street, Narawee

SUMMARY OF ANALYSIS

No.	Sample ID	Chromium Reducible Sulfur (CRS)	Conductivity (1:2) in soil	Conductivity and TDS by Calculation - Soil	Moisture Content	pH in soil (1:2)	Soluble Anions in Soil from 1:2 DI Extract by Ion	SPOCAS Net Acidity Calculations	TAA (Titratable Actual Acidity)	TPA (Titratable Peroxide Acidity)
001	BH101 0.5-0.95	2	2	1	1	1	2	6	7	21
002	BH102 0.3-0.45	2	2	1	1	1	2	6	7	21
003	BH102 0.5-0.95	2	2	1	1	1	2	6	7	21

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Admin
Client	SGS I&E SYDNEY
Address	5058 201 I&E HSE SYDNEY (EX 5258) UNIT 16 33 MADDOX STREET ALEXANDRIA NSW 2015
Telephone	0285940400
Facsimile	0285940499
Email	au.environmental.sydney@sgs.com
Project	**20219/1 24-26 Avon Road, Dee Why**
Order Number	**SE233797**
Samples	3

LABORATORY DETAILS

Manager	Anthony Nilsson
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE160279 R0**
Date Received	04 Jul 2022
Date Reported	07 Jul 2022

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146/19038)

SIGNATORIES

Anthony NILSSON
Operations Manager

Parameter	Units	LOR	Sample Number Sample Matrix Sample Depth Sample Date Sample Name	CE160279.001 Soil 0.5-0.95 29 Jun 2022 SE233797.001	CE160279.002 Soil 0.3-0.45 29 Jun 2022 SE233797.002	CE160279.003 Soil 0.5-0.95 29 Jun 2022 SE233797.003
Moisture Content Method: AN002 Tested: 4/7/2022						
% Moisture	%w/w	0.5		**22**	**20**	**23**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 5/7/2022						
pH KCl	pH Units	-		**3.8**	**5.2**	**3.8**
Titratable Actual Acidity	kg H2SO4/T	0.25		**6.0**	**0.86**	**6.2**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		**122**	**17**	**127**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		**0.20**	**0.03**	**0.20**
Sulphur (SKCl)	%w/w	0.005		<0.005	<0.005	**0.015**
Calcium (CaKCl)	%w/w	0.005		**0.011**	**0.12**	**0.007**
Magnesium (MgKCl)	%w/w	0.005		**0.045**	**0.026**	**0.049**
TPA (Titratable Peroxide Acidity) Method: AN218 Tested: 5/7/2022						
Peroxide pH (pH Ox)	pH Units	-		**4.4**	**3.8**	**4.5**
TPA as kg H_2SO_4/tonne	kg H2SO4/T	0.25		**6.9**	**0.74**	**7.5**
TPA as moles H+/tonne	moles H+/T	5		**140**	**15**	**152**
TPA as S % W/W	%w/w S	0.01		**0.22**	**0.02**	**0.24**
Titratable Sulfidic Acidity as moles H+/tonne	moles H+/T	5		**17**	<5	**25**
Titratable Sulfidic Acidity as kg H_2SO_4/tonne	kg H2SO4/T	0.25		**0.86**	<0.25	**1.2**
Titratable Sulfidic Acidity as S % W/W	%w/w S	0.01		**0.03**	<0.01	**0.04**
ANCE as % $CaCO_3$	% CaCO3	0.01		<0.01	<0.01	<0.01
ANCE as moles H+/tonne	moles H+/T	5		<5	<5	<5
ANCE as S % W/W	%w/w S	0.01		<0.01	<0.01	<0.01
Peroxide Oxidisable Sulphur (Spos)	%w/w	0.005		**0.009**	**0.008**	**0.011**
Peroxide Oxidisable Sulphur as moles H+/tonne	moles H+/T	5		**6**	<5	**7**
Sulphur (Sp)	%w/w	0.005		**0.013**	**0.011**	**0.026**
Calcium (Cap)	%w/w	0.005		**0.013**	**0.14**	**0.009**
Reacted Calcium (CaA)	%w/w	0.005		<0.005	**0.012**	<0.005
Reacted Calcium (CaA)	moles H+/T	5		<5	**6**	<5
Magnesium (Mgp)	%w/w	0.005		**0.048**	**0.028**	**0.051**
Reacted Magnesium (MgA)	%w/w	0.005		<0.005	<0.005	<0.005
Reacted Magnesium (MgA)	moles H+/T	5		<5	<5	<5
Net Acid Soluble Sulphur as % w/w	%w/w	0.005		**0.006**	-	<0.005
Net Acid Soluble Sulphur as moles H+/tonne	moles H+/T	5		<5	-	<5
HCl Extractable S, Ca and Mg in Soil/Solids ICP OES Method: AN014 Tested: 7/7/2022						
Acid Soluble Sulfate, SO4 as S	%w/w	0.005		**0.010**	-	**0.020**
Acid Soluble Sulfur (SHCl)	%w/w	0.005		**0.010**	-	**0.020**
SPOCAS Net Acidity Calculations Method: AN220 Tested: 7/7/2022						
s-Net Acidity	%w/w S	0.005		**0.21**	**0.036**	**0.22**
a-Net Acidity	moles H+/T	5		**130**	**22**	**140**
Liming Rate	kg CaCO3/T	0.1		**9.8**	**1.7**	**10**
Verification s-Net Acidity	%w/w S	-20		**0.00**	**0.00**	**0.00**
a-Net Acidity without ANCE	moles H+/T	5		**130**	**22**	**140**
Liming Rate without ANCE	kg CaCO3/T	0.1		**9.8**	**1.7**	**10**

Parameter	Units	LOR	Sample Number CE160279.001 Sample Matrix Soil Sample Depth 0.5-0.95 Sample Date 29 Jun 2022 Sample Name SE233797.001	CE160279.002 Soil 0.3-0.45 29 Jun 2022 SE233797.002	CE160279.003 Soil 0.5-0.95 29 Jun 2022 SE233797.003
Chromium Reducible Sulfur (CRS) Method: AN217 Tested: 5/7/2022					
Chromium Reducible Sulfur (Scr)	%	0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulfur (Scr)	moles H+/T	5	<5	<5	<5

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulfur (CRS) **Method: ME-(AU)-[ENV]AN217**

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Chromium Reducible Sulfur (Scr)	LB104667	%	0.005	<0.005	91%
Chromium Reducible Sulfur (Scr)	LB104667	moles H+/T	5	<5	

TAA (Titratable Actual Acidity) **Method: ME-(AU)-[ENV]AN219**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH KCl	LB104663	pH Units	-	6.1	0%	101%
Titratable Actual Acidity	LB104663	kg H2SO4/T	0.25	<0.25	4%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB104663	moles H+/T	5	<5	4%	108%
Titratable Actual Acidity (TAA) S%w/w	LB104663	%w/w S	0.01	<0.01	4%	108%
Sulphur (SKCl)	LB104663	%w/w	0.005	<0.005	5%	87%
Calcium (CaKCl)	LB104663	%w/w	0.005	<0.005	1%	105%
Magnesium (MgKCl)	LB104663	%w/w	0.005	<0.005	2%	95%

TPA (Titratable Peroxide Acidity) **Method: ME-(AU)-[ENV]AN218**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Peroxide pH (pH Ox)	LB104665	pH Units	-	6.4	2%	100%
TPA as kg H_2SO_4/tonne	LB104665	kg H2SO4/T	0.25	<0.25	2%	
TPA as moles H+/tonne	LB104665	moles H+/T	5	<5	2%	
TPA as S % W/W	LB104665	%w/w S	0.01	<0.01	2%	
ANCE as % $CaCO_3$	LB104665	% CaCO3	0.01	<0.01	0%	
ANCE as moles H+/tonne	LB104665	moles H+/T	5	<5	0%	
ANCE as S % W/W	LB104665	%w/w S	0.01	<0.01	0%	
Sulphur (Sp)	LB104665	%w/w	0.005	<0.005	0%	93%
Calcium (Cap)	LB104665	%w/w	0.005	<0.005	30%	97%
Magnesium (Mgp)	LB104665	%w/w	0.005	<0.005	1%	91%

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN014	This method is for the determination of soluble sulfate (SO4-S) by extraction with hydrochloric acid. Sulphides should not react and would normally be expelled. Sulfate as Sulfur is determined by ICP.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulfide (H2S) which is collected and titrated with iodine (I2(aq)) to measure SCR.
AN218	Soil samples are subjected to extreme oxidising conditions using hydrogen peroxide. Continuous application of heat and peroxide ensure all sulfide is converted to sulfuric acid. Excess peroxide is broken down by a copper catalyst prior to titration for acidity. Calcium, magnesium, and sulfur are determined by ICP-OES. Also included is a carbonate modification step which, depending on pH after the initial oxidation, gives a measure of ANC.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulfur are determined by ICP-AES.
AN220	SPOCAS Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
***	Indicates that both * and ** apply.	NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

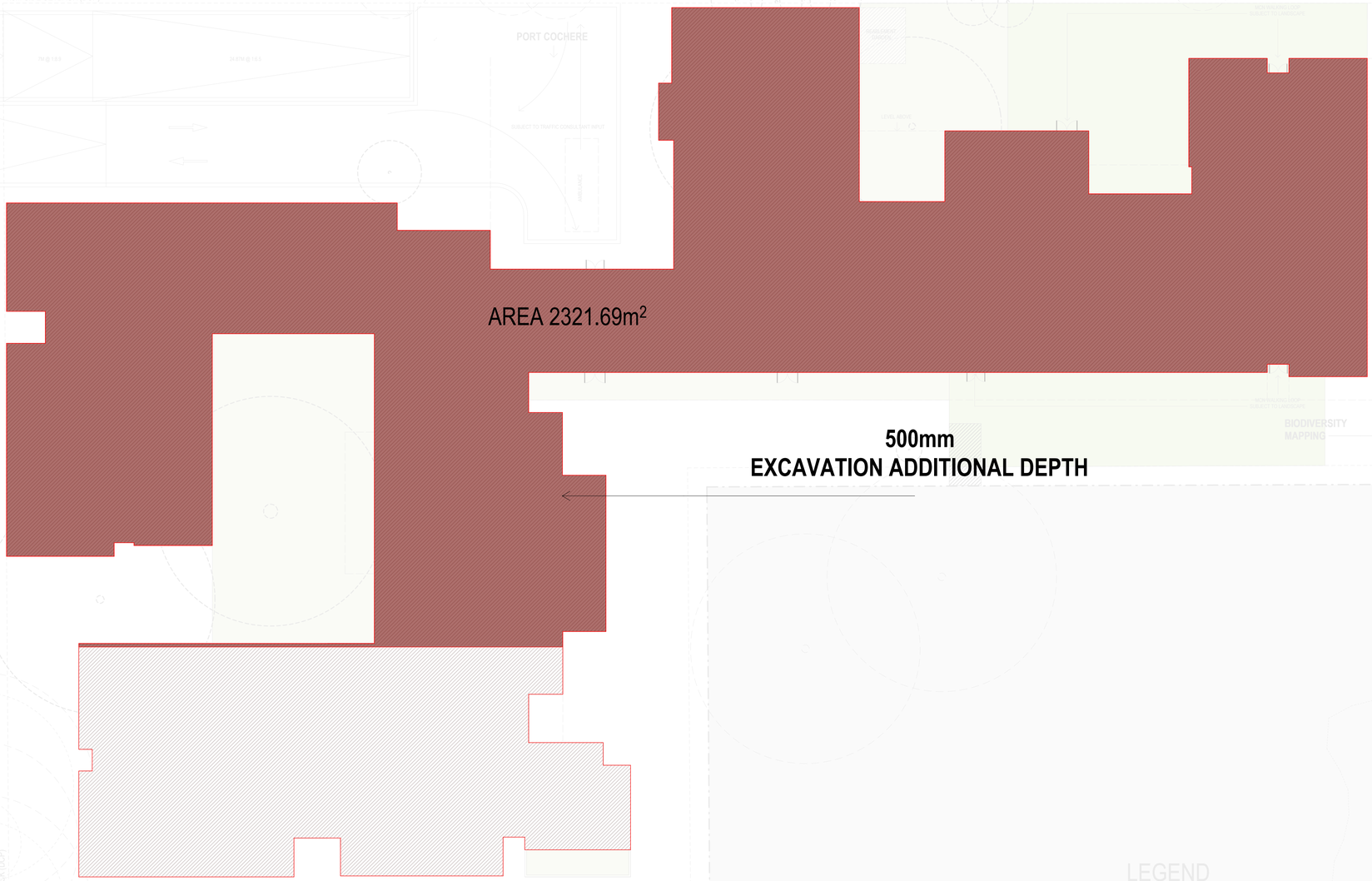
If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

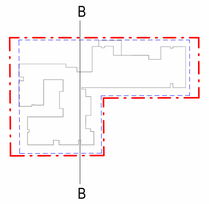
The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

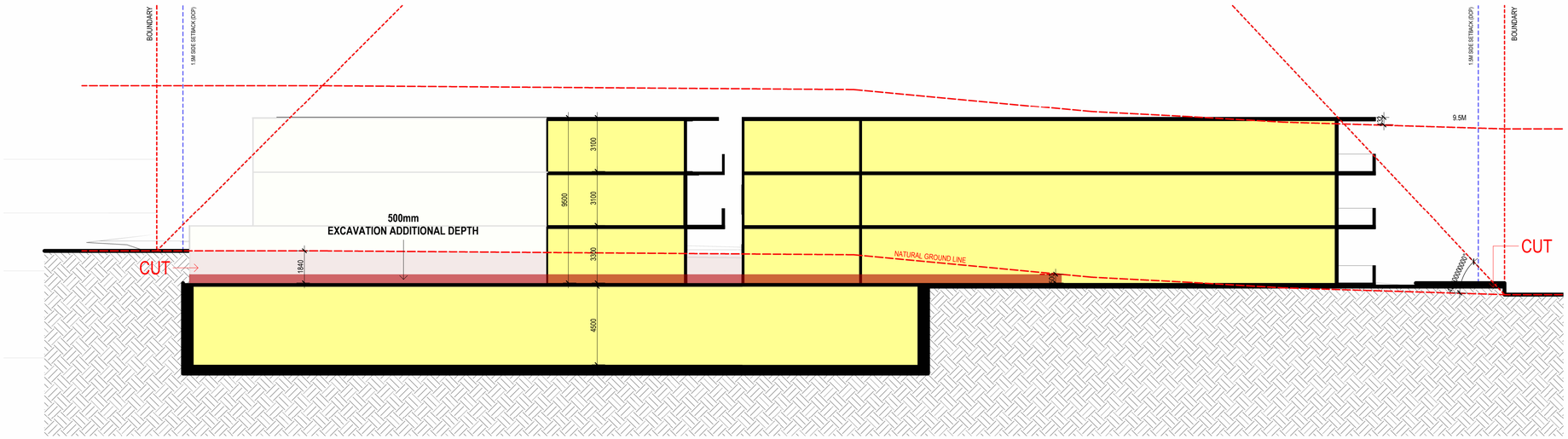


1 GROUND LEVEL - EXCAVATION
1 : 200

NARWEE PARKLANDS CARE COMMUNITY

DRAWING	NUMBER	REVISION	DATE
EXCAVATION MARK	DA4105		08/09/22





1 Section BB
1 : 150

GROUP GSA NARWEE PARKLANDS CARE COMMUNITY

DRAWING	NUMBER	REVISION	DATE
SECTIONS	DA3100		08/09/22