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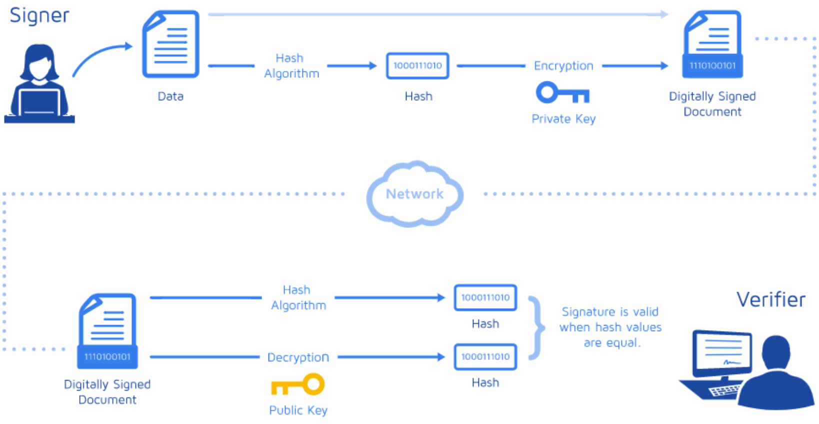

BHM Geotechnical

Geotechnical Investigation

AT

60 & 62-64 Showground Road, Gosford NSW 2250

PREPARED FOR

CHP Fund

Draft

Revised 20 May 2024

Document Reference: CHP 2293 – AA Rev.3
BHM Geotechnical Pty Ltd
Email: info@bhmgeo.com.au
ACN: 642 369 739
ABN: 44 642 369 739

Job No.: CHP 2293
Report No.: AA Rev.3

20 May 2024

Client: CHP Fund

Attention: Mr. Luke Goodwin
Via Email: luke.goodwin@chpfun.com.au

Re:

60 & 62-64 Showground Road
Gosford NSW 2250
GEOTECHNICAL INVESTIGATION

Please find herewith our geotechnical investigation report in relation to the above project.

As requested, BHM Geotechnical Pty Ltd (BHM) has undertaken a geotechnical investigation for the proposed works at the above address.

This report provides details of sub-surface conditions, groundwater conditions and other geotechnical aspects relevant to the proposed development.

Should you have any questions relating to this report, please do not hesitate to contact the undersigned.

Yours faithfully,

Manney Bandara
Associate|Geotechnical Engineer

Document Reference: CHP 2293 – AA Rev.3
Attention: **Mr. Luke Goodwin**
Via Email: luke.goodwin@chpfund.com.au

Geotechnical Investigation Report
60 & 62-64 Showground Road
Gosford NSW 2250

For and on behalf of
BHM Geotechnical Pty Ltd

Digitally signed
by BHM
Date: 2024.05.20
15:20:16 +10'00'

Manney Bandara
Associate|Geotechnical Engineer

Reviewed By

Stephen Muscat
Associate|Geotechnical Engineer

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Rev	Revision Details	Author	Reviewer		Approved for Issue		
			Name	Initials	Name	Initials	Date
0	Initial Issue	M. Bandara	S.Muscat	SM	M.Bandara	MB	22 August 2023
1	Revision One	M. Bandara	S.Muscat	SM	M.Bandara	MB	13 September 2023
2	Revision of proposed development	M. Bandara	S.Muscat	SM	M.Bandara	MB	13 May 2024
3	Revision of RL	M. Bandara	S.Muscat	SM	M.Bandara	MB	20 May 2024

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List of Tables & Figures

APPENDICES

ABBREVIATIONS

Australian Standard	**AS**
Acid Sulfate Soil	**ASS**
Acid Sulfate Soils Management Advisory Committee	**ASSMAC**
Australian Height Datum	**AHD**
Australian Geomechanics Society	**AGS**
Before You Dig Australia	**BYDA**
Borehole	**BH**
Continuous Flight Auger	**CFA**
Density Index	**DI**
Dynamic Cone Penetrometer	**DCP**
Environmental Protection Authority	**EPA**
Excavated Natural Material	**ENM**
Field Density Test	**FDT**
Optimum Moisture Content	**OMC**
Particle Size Distribution	**PSD**
Plasticity Index	**PI**
Reduced Level	**RL**
Standard Maximum Dry Density	**SMDD**
Virgin Excavated Natural Material	**VENM**

Units

Metres	**mmm**
Millimetres	**MPa**
Megapascal	
Percentage	**%**
Kilopascal	**kPa**

1 INTRODUCTION

1.1 General

This report details the results of a geotechnical investigation carried out for the proposed development at "60 & 62-64 Showground Road, Gosford NSW" ("the site"). The investigation was commissioned by Mr. Luke Goodwin representing "CHP Fund" ("the client") in accordance with our fee proposal referenced S2411 Rev.1 dated 26 June 2023 and emailed commission from the client dated 26 June 2023. This revision is issued considering the revised architectural plans referenced "6245.DA.10.03" Rev H.

1.2 Proposed Developments

The proposed development at the site encompasses a mixed-use complex consisting of a health service facility, retail premises, and a residential care facility. The structure will comprise of a five-storey building with three levels of basement parking with a total excavation depth of 12.26 (m bgl). The revised changes include the reduction of one-storey and one basement level, excavation depth and volume of the revised plan is similar to the previous plan, with an insignificant change to the bottom basement depth.

1.3 Scope of the Investigation

The purpose of the investigation is to provide geotechnical data, such as site conditions and associated matters to the relevant parties involved with the proposed development at 60 & 62-64 Showground Road, Gosford NSW.

The geotechnical investigation was carried out in accordance with the agreed scope of works outlined in our proposal. The scope of works carried out on site included:

- Before You Dig Australia (BYDA) enquiry & perusal of associated drawings prior to works;
- Three (3) investigative boreholes using a mechanical drill rig with SPT testing in regular 1.5 m intervals to refusal, followed by NMLC diamond coring to a target depth of 20 m;
- Laboratory testings of point load strength index (I_{S50}) at a frequency of 2 tests per metre on recovered rock core samples;
- Installation of two (2) groundwater wells to monitor groundwater levels at the site;
- Logging of sub-surface profile by a suitably qualified Geotechnical Engineer;
- Backfilling of investigative borehole;
- Review of geological maps for the investigative area;
- Groundwater conditions;
- Review of Acid Sulfate Soil (ASS) risk maps;

- Provide a report detailing the results of the geotechnical investigation recommendations for the design and construction of the proposed development.

Adjustments to the scope may be made whilst on site at our discretion to satisfy the geotechnical objectives provided it is within the provisioned budget.

2 SITE DESCRIPTION

2.1 Site Condition

The site encompassed two rectangular lots on a land size of approximately 2355 m^2. The site is bound to the north and west by Gosford Hospital, to the south by residential dwellings and to the east by Showground Road.

The majority of the site was occupied by the dwellings, while the remaining area was predominately characterised by concrete paving. Grassed areas were present towards the front, complemented by mild vegetation and small to medium-sized trees. Overall, the property was in fair condition based on a cursory inspection.

Topographically, the site is located at the bottom of a slope with the lowest and highest elevations of the site respectively at the front and rear of the existing site with RL values of 10.43 and 15.05 (m AHD), respectively.

The investigative borehole locations were chosen by our supervising geotechnical engineer based upon the location of the proposed construction works. Their locations are overlaid on the proposed plans of the site in Figure 1 below.

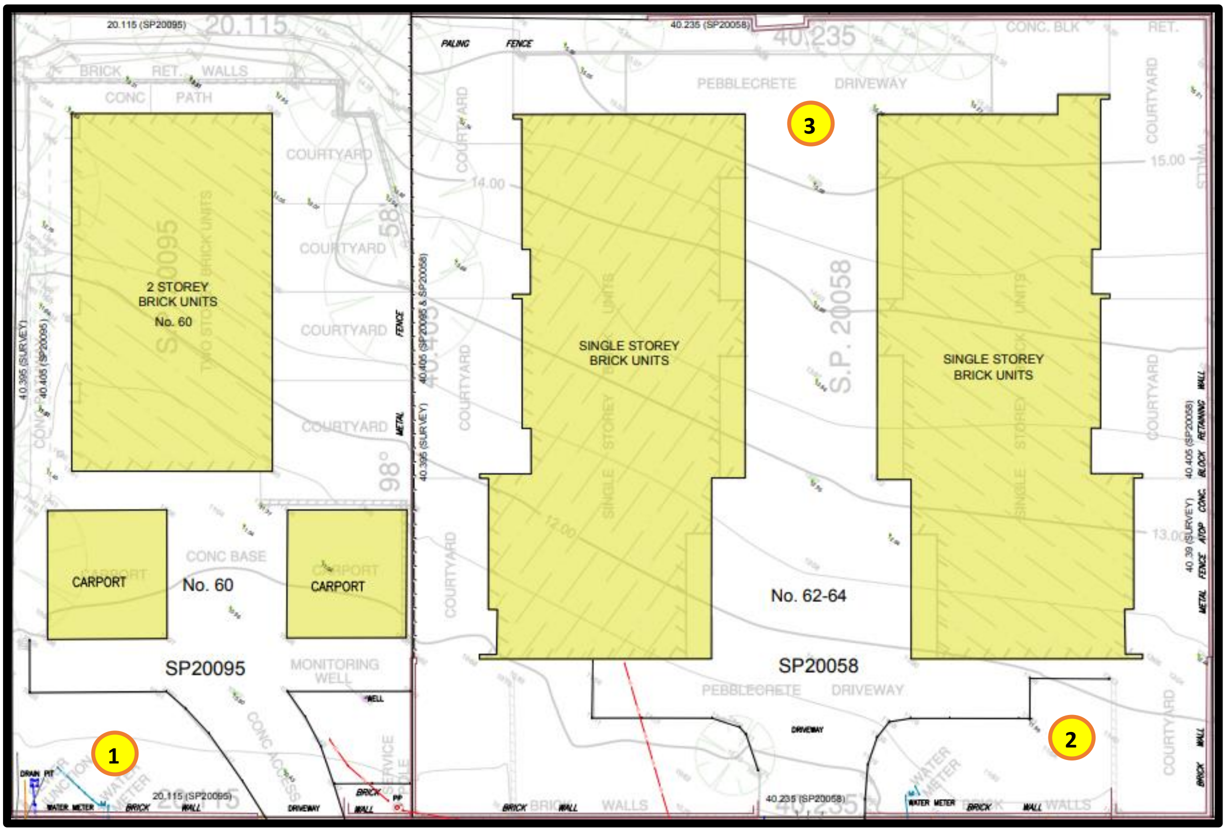

Figure 1 - Borehole & DCP locations

● Denotes approximate borehole location

2.2 Historical Imagery

Figure 2 depicts notable developments of the existing property. As presented in the 1965 aerial imagery within figure 2, the two lots previously featured two residential dwellings. Additionally, the neighbouring northern, southern and western buildings have undergone significant redevelopments since 1965, particularly with the establishment of Gosford Hospital towards the north and west of the property.

Figure 2 - c.1965 Aerial Imagery[1]

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[1] NSW Government (2022). *"Historical Imagery: Search and Discovery"*

2.3 Regional Geology

The location of the proposed site is depicted below (Figure 3) on the Gosford-Lake Macquarie 1:100,000 Geological Map using Google Earth. The geological unit that the subject site falls within is Terrigal Formation, this is further described below:

- **Mesozoic era Middle Triassic –** Interbedded laminite, shale and fine- to coarse-grained quartz- to quartz-lithic sandstone; minor red claystone.

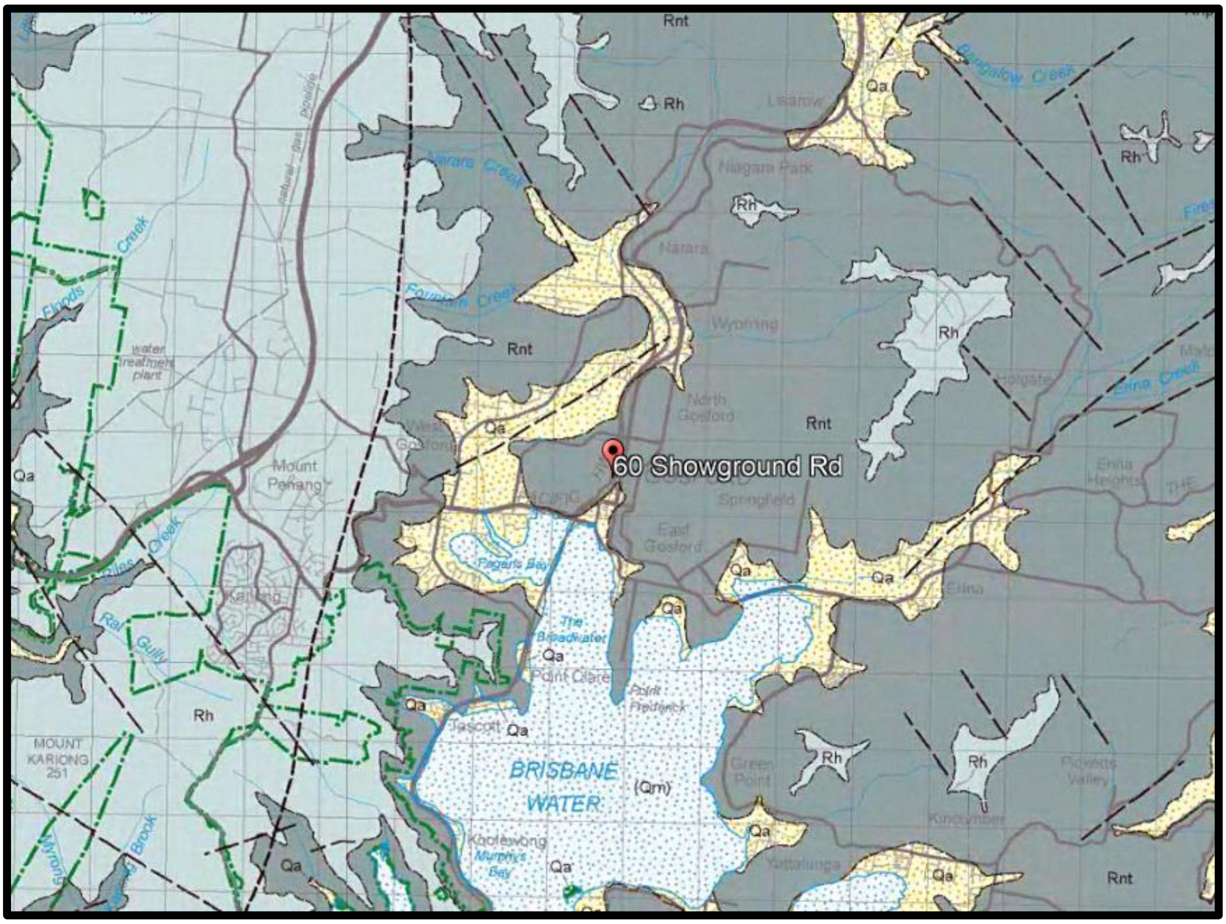

Figure 3 – Gosford-Lake Macquarie 1:100,000 Geological Map[2]

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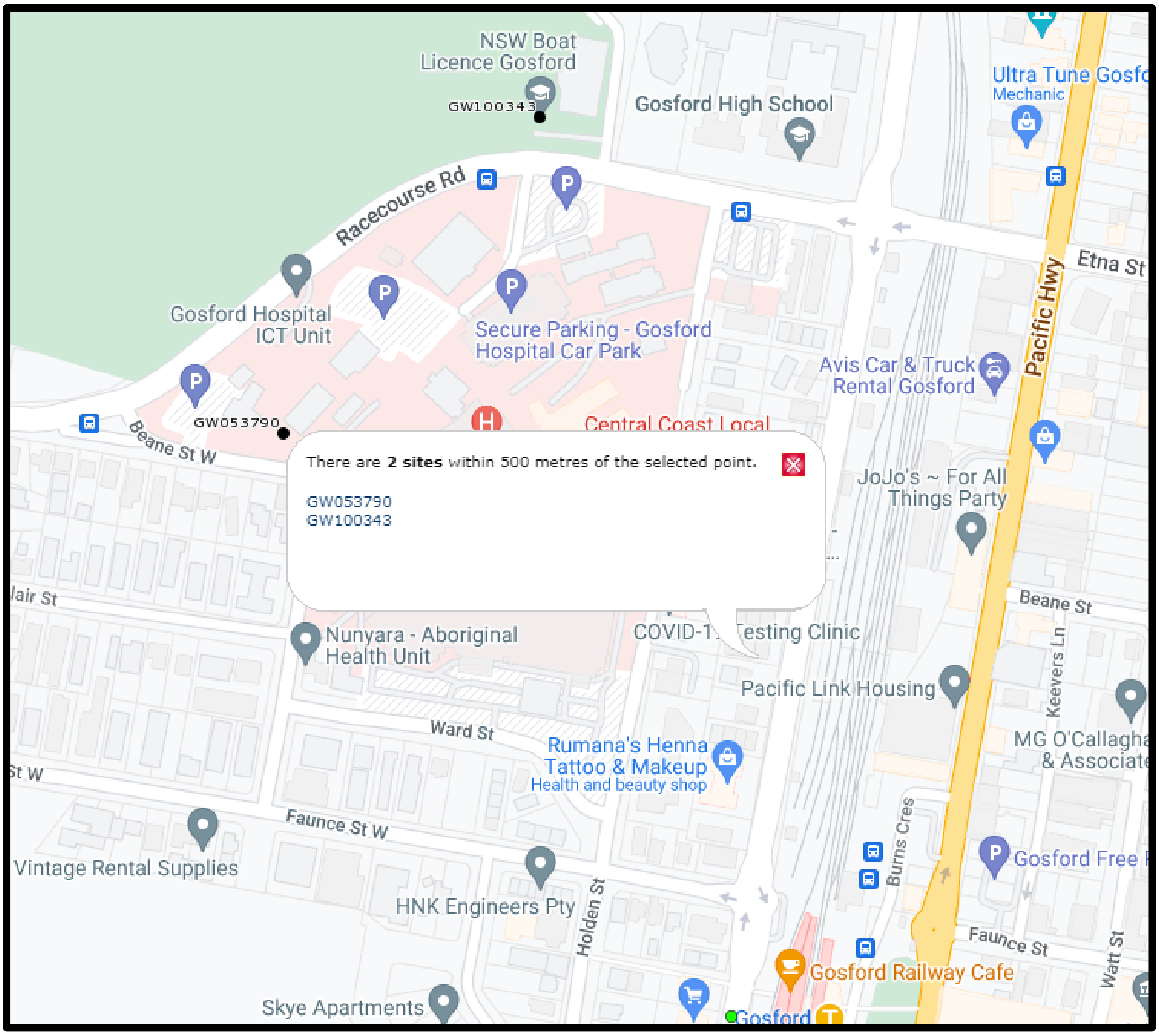
[2] Och D.J., Jones D.C., Uren R.E. & Hughes K.S. (compilers) 2015. Gosford-Lake Macquarie Special 1:100 000 Geological Sheet 9131 & part sheet 9231. First Edition. Geological Survey of New South Wales, Maitland.

2.4 Regional Hydrology

The NSW All Groundwater Map[3] depicted in figure 4 indicates two (2) registered groundwater bores within a 500 m radius of the site for general use. A groundwater bore was present within the southern portion of the site.



There are **2 sites** within 500 metres of the selected point.

GW053790
GW100343

Figure 4 - NSW All Groundwater Map

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[3] Water NSW. 2022. NSW All Groundwater Map

2.5 Acid Sulfate Soil (ASS) Risk and Planning

Acid sulfate soils are naturally occurring soils containing iron sulfide minerals, principally pyrite. Significant environmental hazards including acidification of soil can occur when ASS is exposed to oxygen, as a result of disturbance through construction activities.

ASSMAC[4] recommends that the following geomorphic or site criteria should be used to determine if acid sulfate soils are likely to be present:

- Sediments of recent geological age (Holocene);
- Soil horizons less than 5 m AHD;
- Marine or estuarine sediments and tidal lakes;
- The site is located within in coastal wetlands or back swamp areas; waterlogged or scalded areas; interdune swales or coastal sand dunes (if deep excavation or drainage proposed);
- The site is located within an area where the dominant vegetation is mangroves, reeds, rushes and other swamp-tolerant or marine vegetation such as swamp mahogany (Eucalyptus robusta), paperbark (Melaleuca quinquenervia) and swamp oak (Casuarina glauca);
- The site is located within areas identified in geological descriptions or in maps as bearing sulfide minerals, coal deposits or former marine shales/sediments (geological maps and accompanying descriptions may need to be checked);
- The proposed development activities would disturb deep older estuarine sediments >10 metres below ground surface, Holocene or Pleistocene age (only an issue if deep excavation or drainage is proposed).

The site is not located in an ASS risk area according to the risk maps prepared by the Department of Land and Water Conservation[5]. Based on our assessment of the above information, no criteria for ASS have been triggered on this site. Therefore, further assessment of ASS is not deemed necessary.

---

[4] Ahern C R, Stone, Y, and Blunden B (1998). Acid Sulfate Soils Assessment Guidelines Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

[5] NSW Government. 2022. SEED The Central Resource for Sharing and Enabling Environmental Data in NSW. *"OpenStreetMap"*.

3 METHOD OF INVESTIGATION

The fieldwork for this investigation was carried out over a total of three (3) days, from the 3rd of July 2023 to the 5th of July 2023 and included the drilling of three (3) investigative borehole using a mechanical drill rig fitted with solid flight augers attached with a Tungsten-Carbide bit to refusal, followed by NMLC diamond coring to a target depth of 20 m. The resulting soil and rock profile was logged by the supervising engineer in accordance with Australian Standard 1726[6].

Standard Penetration Testing (SPT) within the borehole locations were undertaken in regular 1.5 m intervals in accordance with Australian Standard 1289.6.3.18[7]. SPT tests involves drilling a vertical hole of at least 65 mm diameter to the depth at which the test is to be conducted. The sampler is driven 450 mm and the number of blows for each successive 150 mm of penetration is recorded. The first 150 mm is considered to be the seating drive and the remaining 150 mm intervals are added and termed the penetration resistance (N).

Recovered rock cores were plastic wrapped to maintain field moisture content and then transported to a NATA accredited laboratory under standard chain of custody protocols for I_{s50} point load testing. Point load testing was carried out in accordance with AS 4133.4.1[8]

At the completion of boreholes BH02 and BH03, groundwater monitoring wells were installed to gather groundwater data on site. Further details relating to the construction of ground water monitoring wells can be found in section (4).

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[6] Australian Standard AS 1726 -2017 “Geotechnical site investigations” on the day of investigation. The boreholes were backfilled on completion of site work.

[7] Australian Standards 1289.6.3.1 – 1997 “Methods of testing soils for engineering purposes soil strength and consolidation tests - Determination of the penetration resistance of a soil - 9kg dynamic cone penetrometer test”

[8] Australian Standard AS 4133.4.1 – 2007 “Methods of testing rocks for engineering purposes – Rock strength tests – Determination of point load strength index”.

4 GROUNDWATER

During the excavation of boreholes 01, 02 and 03, groundwater seepage was observed at depths of 5.5 m, 6.5 m and 4 m, respectively. Subsequently, boreholes 02 and 03 were converted into groundwater monitoring wells. The groundwater within the monitoring wells was bailed out on the 31st of August 2023. The screen installed within borehole 02 was constructed to isolate the extremely weathered bedrock. Initial measurements indicated the groundwater level at 1.7 (m bgl) before the water was bailed out. Groundwater extraction was performed until it reached a depth of approximately 9.4 (m bgl). Water bailing was terminated due to the presence of sludge at greater depths.

Similarly, screens were installed within borehole 03 to isolate the natural soil. The initial groundwater measurement within borehole 03 was measured at 1.9 (m bgl) prior to bailing. Groundwater was bailed to a depth of approximately 4.1 (m bgl). As with borehole 02, water bailing was terminated due to the presence of sludge at greater depths, preventing further extraction of groundwater.

Groundwater recharge results have been tabulated in a graph and presented within tables 1 & 2.

Table 1 - Groundwater Recharge Rate (BH02)

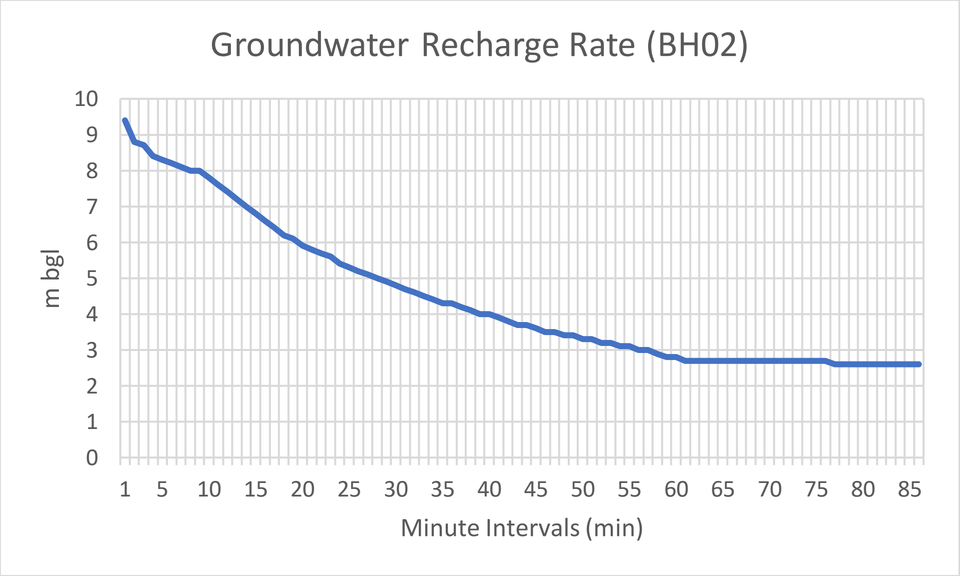
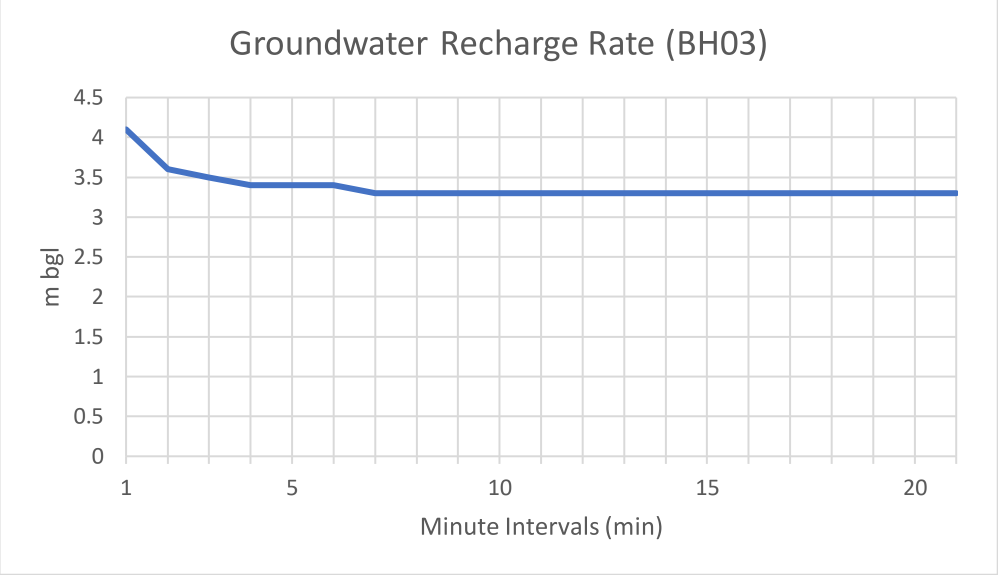


Table 2 - Groundwater Recharge Rate (BH03)



4.1 Dewatering

Based on the information provided from the groundwater wells, isolating the extremely weathered bedrock and natural soils, the standing groundwater level on site was measured at approximately 1.7 m and 1.9 m bgl within boreholes 02 and 03, respectively.

To minimise the effect of groundwater on the development and adjacent properties the following sequence of construction is recommended. A completely interlocking secant pile shoring wall is to be constructed around the perimeter of the basement to provide a solid barrier free of gaps, preventing water seepage. Anchors will not be possible due to the likely ingress into the neighbouring properties, therefore internal bracing should be selected and be either temporary or as part of the permanent structure. The shoring wall and bracing system should be designed by the structural engineer, however we may be engaged to undertake analysis to confirm the total deflections, this will enable us to back feed our predicted deflection with the observational data obtained from the monitoring and management plan.

After the completion of the secant pile shoring wall system, it is recommended that four (4) dewatering wells be installed internally to gradually dewater the proposed basement prior to excavation. The groundwater level may be reduced by a depth of 2 m below the excavation depth, followed by excavation, this process is to be repeated to achieve the desired target excavation depth. These pumps should be continuously operated through the excavation period. Appropriate water quality testing is to be conducted to determine whether the water can be discharged into stormwater pits. Given the sludging observed within BH03, it is likely that that the wastewater will need to be treated with a coagulant, to remove suspended solids within the water prior to discharge. The solids should then be disposed of to a tip as general solid waste, subject to further testing in accordance with the EPA requirements for classifying waste.

Based on the data obtained from the groundwater wells, we estimate that the total groundwater inflow is estimated to be approximately 14.14 m^3/day. To eliminate the need for permanent dewatering measures, a tanked basement comprising of water-tight walls and floors is recommended, it is good practice to incorporate a hydrostatic pressure release valve in the event of elevated hydrostatic pressure that may occur throughout the lifetime of the building. The volume of water ingress will ultimately be contingent upon various factors, including soil permeability, rock fracturing and weather conditions.

Sump and pump techniques may be used to dewater potential surface water from rainfall events. The potential of dewatering and off-site disposal into stormwater systems will depend on council approval and contamination status of the groundwater and other properties, such as pH levels and total suspended solids.

BHM recommends undertaking a hydrogeological analysis to estimate the total dewatering rates and water reinjection. BHM may be commissioned to undertake the analysis.

Table 3 - Groundwater Well Data

Borehole Number	Water Volume (m^3)	Inflow Rate (m^3/day)
1	0.015	1.13
2	0.004	<1.00

5 GEOTECHNICAL INTERPRETATION

Assessment of the ground conditions at the specified area has been undertaken to develop a geotechnical model of the site. A summary of the subsurface horizons is presented below, borehole logs can be found within Appendix A of this report for a more detailed description.

CONCRETE

A concrete pavement, measuring approximately 0.1 m in thickness was overlain the fill profile within borehole 3.

Fill

Fill material mainly consisted of brown, low to medium plastic clay mixtures between depths of 0 – 1.5 m. Moisture content throughout the fill profile was equal to the plastic limit. Fill profile was poorly compacted at the tested locations and is considered to be uncontrolled fill.

Horizon A – ALLUVIAL SOILS

The soil profile encountered predominately comprised of alluvial soils with depths ranging between 1.0 – 2.0 m. The majority of this unit consisted of brown, low to medium plasticity sandy clay with moisture content equal to the plastic limit. The consistency at the tested locations were assessed to be stiff to very stiff.

Horizon B – RESIDUAL SOILS

The soil profile encountered predominately comprised of residual with depths ranging between 2.0 – 9.0 m. The majority of this unit consisted of red mottled grey, low to medium plastic clay with moisture content greater than the liquid limit. The consistency at the tested locations were assessed to be very stiff to hard.

Horizon C/D/E – SANDSTONE/SILTSTONE BEDROCK

Residual soils were underlain by black/dark grey siltstone bedrock and fine to medium-grained grey sandstone bedrock. Bedrock material ranged from extremely weathered to fresh and ranged from Class V to Class II. Strength and quality of the sandstone rock increased with depth.

The results of the investigation have been used to develop the following geotechnical model presented in Table 1 for the site.

Table 4 - Geotechnical model

Horizon	Stratum	Depth to top of unit (m)	Thickness* (m)	RL (m AHD)	Class
Surface	CONCRETE	Ground surface	0.1	15.13	
Fill	Fill	0 – 0.1	1 – 1.4	10.81 – 15.12	-
A	Alluvial CLAY	1 – 1.5	1 – 1.5	9.81 – 13.63	-
B	Residual CLAY	2 – 3	1.5 – 7	7.24 – 12.13	-
C	Sandstone BEDROCK	4.5 – 9	5.3 – 6.84	2.94 – 10.63	V
D	Siltstone BEDROCK	9.8 – 14.54	Not defined	-3.73 – 5.33	II

*Depths and unit thicknesses are based on the information obtained from the borehole logs as well as correlation with the SPT test data and do not represent the minimum and maximum values on site.

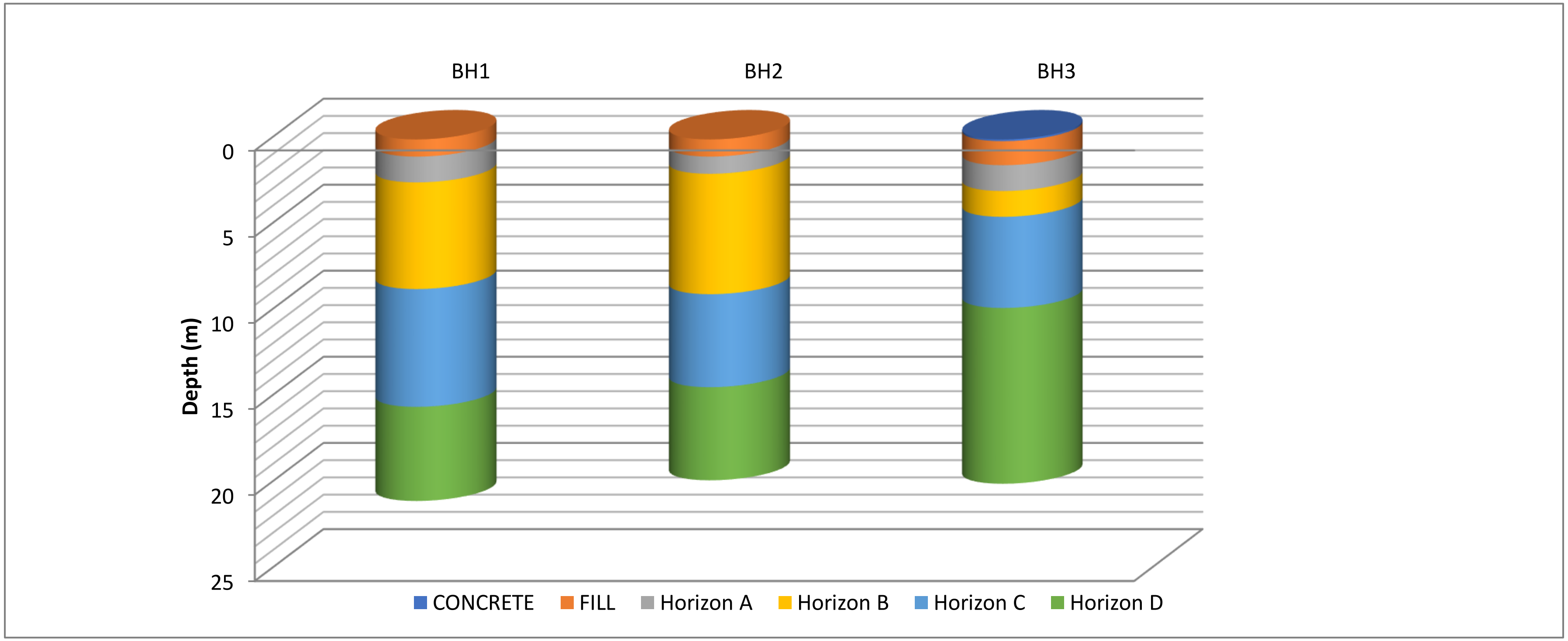


Figure 5 - Geotechnical Model

6 GEOTECHNICAL RECOMMENDATIONS

6.1 Subgrade Preparation

This section is only intended to be used as guide and is not a substitute for professional advice from a geotechnical engineer. Site specific geotechnical advice should be sought before any filling works are attempted as some or all information may not be appropriate for the specific site conditions and development.

The following general recommendations are provided for preparation of the subgrade under development areas.

- All topsoil and uncontrolled fill materials are to be stripped from the site with any unsuitable or deleterious materials removed. This material is to be stockpiled for re-use as landscaping materials or removed from the site.
- All-natural soil and rock materials excavated are to be stockpiled for the re-use as engineered fill or removed from the site.

6.2 General Earthworks

Table 5 - Earthwork's specifications

Material Type	Fill Type	Minimum Relative Compaction %	Moisture Content
Cohesive Materials	General Fill	95% SMDD	± 2% OMC
	Subgrade	98% SMDD	± 2% OMC
	Foundation/ upper 300 mm	98% SMDD	± 2% OMC
Non-cohesive Materials	General Fill	70% DI	NA[1]
	Subgrade	75% DI	NA[1]
	Foundation/ upper 150 mm	80% DI	NA[1]

Note:

1. Material shall be moist but no weight during placement or as directed by the supervising Geotechnical Engineer.

Where engineered fill is it be to be used to raise the ground level, all material shall be in accordance with the section 4 of AS 3798[9] as a guide the following may be used to aid in the selection of suitable fill material.

- Before any loose layer of fill is compacted, the material and its moisture condition should be as uniform as practicable throughout its depth.
- Fill material shall be free organics soils, root- affected subsoils and peat.
- Fill material shall be free of contamination and shall either be classified as VENM or ENM and accordance with Council guidelines.
- Silts or materials that have deleterious engineering properties of silt.

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[9] Australian Standard AS 3798-2007 "Guidelines on earthworks for commercial and residential developments"

- Soils should have Plasticity Index (PI) of less than 25.
- Fill material shall be compacted in layers not exceeding 200 mm loose
- Fill material shall be placed in near horizontal layers of uniform thickness, deposited systematically across the fill area and compacted with a suitable sized plant.
- Fill layers shall be test-rolled immediately following completion of compaction of each layer. Proof roll tests must be supervised by a suitably qualified geotechnical engineer.

Any importation of fill material onto site or re-use of fill material on site, must be classified in accordance with the current NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014)[10] and assessed for suitability from geotechnical perspective. Both criteria must be satisfied before any filling works are attempted. Fill that that may be acceptable from contamination point of view may be unsuitable from geotechnical perspective and vice versa.

Any soil material proposed to be exported off-site must be classified by a suitably qualified environmental engineer in accordance with the current NSW EPA (2014)[11] Waste Classification Guidelines, ENM Order[12] and POEO Act[13].

6.2.1 Strip Inspection

On completion of subgrade preparation works described in section 6.2, the proposed subgrade level shall be subject to a strip inspection by a suitably qualified geotechnical engineer. The strip inspection shall either confirm the suitability of the subgrade material or further geotechnical advice provided to undertake subgrade remedial works. The strip inspection shall consist of proof roll assessment undertaken with appropriately sized plant such as an 8 tonne smooth drum roller or fully loaded watercart in accordance with the with AS 3798[14]. The proposed subgrade level shall be proof roll by at least two (2) passes in a perpendicular direction to each other and/or to the satisfaction of the geotechnical engineer supervising the assessment. The final decision to either accept or reject the proposed subgrade level shall rest with the geotechnical engineer.

6.3 Underpinning

Where excavations extend below the 'zone of influence of existing footings, these must be underpinned. Specific advice must be sought on sequencing and methodology for underpinning, the proposed methodologies must be approved by the structural and geotechnical engineer. As a guide, excavation of

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[10] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (Referred to as Waste Classification Guidelines 2014)

[11] NSW EPA, (2014). *Waste Classification Guidelines*.

[12] NSW EPA, (2014). *Resource Recovery Order under part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014.* (Referred to as "The excavated natural material order 2014")

[13] NSW Legislation (1997). *Protection of the Environment Operations Act 1997 No 156.*

[14] Australian Standard AS 3798-2007 "Guidelines on earthworks for commercial and residential developments"

large sections below the footing should be avoided, instead works should be staged. The zone of influence below footings can vary depending on the properties of the material encountered, however, as a guide, a 45° angle may be adopted to establish the zone which is under the influence of existing footings. Should there be the potential for any proposed excavations to extend into the zone of influence of existing footings, these must be investigated by the means test pits before any excavations are attempted. The design of underpinning support may be carried by suitably qualified structural engineer, subject to appropriate site-specific geotechnical input.

6.4 Excavatability Recommendations

The excavation for the proposed development is anticipated to be encounter mostly bedrock at depths ranging from 4.0 to 9.0 (m bgl). Excavation within fill would be achievable using conventional earthmoving equipment such as a hydraulic excavator bucket. Excavation of extremely weathered siltstone or sandstone may also be achievable using conventional earthmoving equipment attached with a tooth bucket or single ripper attachment.

Where rock quality becomes greater at depth, excavation will require the use of hydraulic hammers supplemented with rock sawing and rock splitting techniques. A chart indicating the rippability rating is presented within Table 3.

As percussive excavations are expected to occur within bedrock, vibration emissions envelope should be specified to adjoining structures and management plan with excavation techniques to be chosen accordingly. Our office may be commissioned to prepare vibration monitoring and management plan once the proposed excavation methodologies have been determined.

Table 6 - Rippability Rating Chart by Weaver (1975)

Rock class	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic velocity (m/s)	>2150	2150-1850	1850-1500	1500-1200	1200-450
Rating	26	24	20	12	5
Rock hardness	Extremely hard rock	Very hard rock	Hard rock	Soft rock	Very soft rock
Rating	10	5	2	1	0
Rock weathering	Unweathered	Slightly weathered	Weathered	Highly weathered	Completely weathered
Rating	9	7	5	3	1
Join spacing (mm)	>3000	3000-1000	1000-300	300-50	<50
Rating	30	25	20	10	5
Joint continuity	Non-continuous	Slightly continuous	Continuous – no gouge	Continuous – some gouge	Continuous – with gouge
Rating	5	5	3	0	0
Joint gouge	No separation	Slight separation	Separation <1 mm	Gouge <5 mm	Gouge >5 mm
Rating	5	5	4	3	1
***Strike and dip orientation**	Very unfavourable	Unfavourable	Slightly unfavourable	Favourable	Very favourable
Rating	15	13	10	5	3
Total rating	100-90	90-70+	70-50	50-25	<25
Rippability assessment	Blasting	Extremely hard ripping and blasting	Very hard ripping	Hard ripping	Easy ripping
Tractor selection	-	DD9G/D9G	D9/D8	D8/D7	D7
Horsepower	-	770/385	385/270	270/180	180
Kilowatts	-	575/290	290/200	200/135	135

6.5 Batter Slopes

Based on the supplied documentation, bulk excavation works of approximately 12.26 (m bgl) are anticipated for the proposed developments. This section is intended to be used as guide for constructing temporary batters during the course of constructions works and not retaining walls. Site-specific geotechnical advice in relation to earth retaining structures have been provided within section 8 of this report.

BHM advises that vertical excavations on this site must not be attempted without seeking further geotechnical advice.

All temporary batters must be constructed in accordance with the table provided below to maximum height of 1.5 m. Appropriate exclusions zones are to be maintained from the crest of the batters, exclusions zones must be kept clear of personnel, equipment, stockpiles, plant or anything that would add additional surcharge loads. The obligation is upon the person undertaking works to seek Geotechnical advice should there be any doubt as what is required, should this be required BHM can be commissioned to do so.

Table 7 - Maximum Batter Slope

Horizon	**Maximum Batter Slope (H:V)**	
	Temporary – 1 Month	**Permanent – 12 months**
Fill/ A/ B	2:1	3:1

Adequate site drainage is to be maintained and surface runoff should always be directed away from the excavation faces. The batter face is to be monitored by the client on a daily basis and hourly during significant rainfall (>10mm/day). If the condition of the batter changes such as flooding, cracking, partial collapse or further excavation, BHM must be contacted for further advice.

6.6 Design Parameters

6.6.1 Siltstone & Sandstone Class

The classification of undisturbed rock cores was undertaken accordance with P.J.N PELLS et al.[15] (Pells report) and presented within Tables 4 and 5. The siltstone and sandstone rock recovered from boreholes 1, 2 and 3 can be classified as Class V sandstone up to depths of 16.2, 16.8 and 9.8 (m bgl), respectively,

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[15] Pells, P.J.N., Mostyn, G. and Walker, B.F., 1998. Foundations on sandstone and shale in the Sydney region. *Australian Geomechanics*, *33*(3), pp.17-29.

thereafter Class III sandstone within borehole 1 to 16.7 m, class II shale was encountered at the depths specified within tables 4 and 5 based on our investigated locations. The classification of shale and sandstone requires 3 criteria to be met, this includes strength, defect spacing and allowable seams. The current classification was predominantly governed by the allowable seams and defect spacings. Diagrams of the investigative boreholes undertaken are presented within Appendix D of this report.

Table 8 - Summary of Rock Classifications

Stratum	Approximate **Reduced Level at top of stratum (m AHD)**		
	BH01	**BH02**	**BH03**
Class V	3.11	2.94	10.63
Class III	-5.39	-	-
Class II	-5.89	-4.86	5.33

Table 9 - Classifying encountered rock

Borehole Number	**Depth (m BGL)**	**Defect Spacing, mm**	**Seams, %**	**Class**	**Material Type**
1	7.7+	>60	N.A.	V	Sandstone
	16.2+	>60	N.A.	III	Sandstone
	16.7+	>200	N.A.	II	Siltstone
2	9+	>60	N.A.	V	Sandstone
	16.8+	> 200	4%	II	Siltstone
3	4.5+	>60	N.A.	V	Sandstone
	9.8+	>200	4%	II	Siltstone

7 FOOTING RECOMMENDATIONS

Appropriate footings for the proposed works would include deep footings adopting the allowable bearing pressures indicated in Table 1 below. Options for footings are:

7.1 Bored Piles

Bored cast-in situ piles may require a sacrificial sleeve as excavation walls may likely collapse. Groundwater seepage is expected within bored pile holes. Drilled spoil is produced during bored excavations and must subsequently be removed from the site in accordance with EPA requirements.

The founding depth in Table 1 is the estimated depth for the corresponding allowable bearing pressure (kPa) in the investigated locations only, these values are applicable for bored or CFA piles. This depth is subject to natural variation across the site and should be inspected by a geotechnical engineer prior pouring concrete for any footings to verify suitable founding material is reached in all footings.

7.2 Footing Design Parameters

Table 10 - Footing design data

Founding Material	Founding Depth (m)	Allowable Bearing Capacity (kPa)	Allowable Shaft Adhesion compression (kPa)*		Minimum Socket length (m)	Socket Specification
			Compression	Tension		
Horizon E	**9.8-16.8+**	**3500**	**200**	**50**	**Subject to structural design**	Class II Siltstone

Note:

1. Subject "R2" roughness specification being achieved; all piles must be drilled under the direct supervision of suitably qualified geotechnical engineer.

The following criteria is recommended for the design and construction of footings:

- The footings may be proportioned for a maximum allowable end bearing capacity presented in Table 3 within the relevant soil strata.
- A suitably qualified Geotechnical Engineer must inspect the bored excavations for the piles to confirm the pile specifications have been achieved whilst excavation equipment is still on site.
- All footings for the same structure must be found in material of similar composition and strength to minimise to risk of differential settlement.
- All loose or softened debris should be cleared from the base of all footings prior to pouring of concrete.

- All footings must be poured immediately after excavation/drilling, removal of water, cleaning, and inspection.

It should be noted that the allowable bearing capacities provided have taken a conservative approach which takes into account the comprehensiveness of the investigation program carried out and the anticipated level of construction phase inspections and control to be undertaken. These values may be revised in accordance with the AS 2159, using a limit state design criterion if required.

Appropriate socket depths for the footings are to be adopted in accordance with the structural engineer's recommendations. Where sockets are specified, drilling of piles shall be supervised by a suitably qualified geotechnical engineer. BHM are to review the final design documents & specifications prior to construction to confirm the intent of our recommendations have been correctly implemented.

It should be confirmed that all footings for each structure are founded on similar material to prevent differential settlement. Footings should always be found on clean, dry, level ground.

Prior to the placement of concrete, it is recommended that a qualified geotechnical engineer approve any footing excavations to confirm that bearing capacity and/or footing depth requirements have been achieved. It should also be confirmed that all footings for each structure are founded on similar material to prevent differential settlement. Footings should always be found on clean, dry, level ground.

8 RETAINING PARAMETERS

8.1.1 Retention Recommendations

Based on the nature of the site and the proposed works, unsupported deep excavation sides are not recommended. Appropriately designed shoring walls will be required. BHM advises that vertical excavations on this site must not be attempted without an adequate retaining or shoring solution.

8.1.2 Retaining Options

BHM recommends that that a braced cantilevered secant pile wall be designed with the parameters provided below. A providing a fully interlocking structure which can prevent groundwater flow into the site and therefore collapse behind the wall due fine particles being transported with the flowing groundwater. This would minimise the need for dewatering, except for during construction works when some groundwater flow may be expected. A contiguous pile walls or closely spaced piles which have been used in conjunction with shotcrete to provide an effective seal that stops collapse of soils behind the wall into the site may also be used. Either wall type is effective provided construction is carried out by experienced contractors who have developed work methods and techniques to provide a fully emasculating wall system. After completion of our groundwater assessment, our recommendations for retention options shall be reviewed taking into account the groundwater conditions of the site.

Excavation will need to be carefully monitored as they progress with inclinometers installed on all boundaries.

Excavation will need to be continuously dewatered, until concrete is poured. Shoring systems may be designed using the following parameters provided in the table below.

Table 11 - Retaining parameters

Material	'Active' Lateral Earth Pressure Coefficient (K_a)[1]	'At Rest' Coefficient (K_o)[1]	'Passive' Coefficient (K_p)[2]	Ultimate Passive Earth Pressure (kPa)
Fill: Sand	0.54	0.70	1.8	-
Natural Clay	0.39	0.56	2.56	-

Material	'Active' Lateral Earth Pressure Coefficient (K_a)[1]	'At Rest' Coefficient (K_o)[1]	'Passive' Coefficient (K_p)[2]	Ultimate Passive Earth Pressure (kPa)
Extremely weathered Sandstone	0.15	0.25	3	-
Medium strength and higher Siltstone	0	0	-	3000

Note:

2. These values assume that some wall movement and relaxation of horizontal stress will occur due to the excavation. Actual in-situ K_0 values may be lower, particularly in the rock units.
3. Includes a reduction factor to the ultimate value of K_p to consider strain incompatibility between active and passive pressure conditions. Parameters assume horizontal backfill and no back of wall friction.
4. Includes a reduction factor to account for local shear failure.

The retaining walls should be designed to withstand some hydrostatic pressure unless measures are taken to ensure complete and permeant drainage. All surcharge loads should also be considered in the design of retaining walls.

The parameters for the 'at rest' condition (K_o) should be used for the design of lateral earth pressures where adjacent footings/structures are located within the 'zone of influence' of the wall. The 'zone of influence' may be taken as a line extending upwards and outwards at 45° above horizontal from the base of the wall. For assessment of passive restraint embedded below excavation level, we recommend a triangular pressure distribution. Piles for braced walls should be socketed at least 0.75 m below the slab subgrade level to provide toe "kick-in" resistance until concrete for the slab can be poured.

Caution will be required not to over-compact and cause excessive lateral pressures on the retaining walls. The abovementioned earth pressure parameters apply to a horizontal backfill surface and, if inclined backfill surfaces are to be designed, then the above factors would have to be increased or the inclined section of backfill should be taken as a surcharge load in the design.

8.1.3 Anchors

Design of anchored retaining walls should be numerically modelled to ensure that deflections are within tolerable limits. The design of retaining structures should take into consideration surcharge loads from adjacent infrastructure. Design of anchors may use the bond stress parameters provided below.

Table 12 – Anchor Bond Stress

Material	Allowable Bond Stress (kPa)
Class II Shale	250

All anchors must be 'pull out' tested to ensure that minimum design strength is achieved, it is recommended that pull-out test be carried out to exceed the allowable bond stress by 130%. The parameters provided in Table 8 assume anchor hole drillings are supervised by a geotechnical engineer and that holes are adequately cleaned and grouted.

8.1.4 Rock stress relaxation

Large in-situ stresses which are created during the formation of siltstone and sandstone bedrock are usually present in a rock mass. For major excavation as proposed; there is a possibility that there will be some horizontal movement within the rock mass due to rock relaxation as the excavation de-stresses the rock mass. It is unlikely to be practicable to provide restraint for the high horizontal stresses anticipated within shale. Relaxation of the rock mass resulting from a reduction of lateral stress as result of the excavation will likely cause horizontal movements along the rock bedding surfaces and partings.

9 CONSTRUCTION PHASE INSPECTIONS & FURTHER GEOTECHNICAL INPUT

The client and builder should familiarise themselves of critical geotechnical inspections required as well as council geotechnical policy. Geotechnical advice must be sought if we have not clearly expressed an opinion on any aspect of a particular issue.

9.1.1 Salinity & Aggressivity

We have not undertaken any salinity & aggressivity assessments as part of this commission. The designers should satisfy themselves that this aspect has been appropriately addressed either using conservative values or undertaking a salinity & aggressivity assessment.

9.1.2 Vibrations

Where excavations are expected to result in significant vibrations to existing structure and buildings, a vibration assessment and if required management plan should be prepared. Sources of vibration include things such as excavation into rock, demolition works and compaction equipment used to undertake earthworks.

9.1.3 Hold Points

The following inspections must be carried out by a suitably qualified geotechnical engineer during the construction process.

1. Geotechnical Engineer to review final structural documentation for their suitability from a geotechnical standpoint.
2. Contractors Geotechnical Engineer to inspect the excavation in every 1.5 m and be approved to proceed.
3. Contractors Geotechnical Engineer to be present on site at all times during drilling of piles.
4. Should rock bolts or anchors be chosen to be used as part of the design, the contractors geotechnical engineer must be present on site during the drilling of the bolt holes.

10 LIMITATIONS

The recommendation and conclusions presented in this report are only valid when read in its entirety, no part or section of this report should be read on its own. The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and BHM accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long-term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage. The satisfactory control and assessment of these items may require judgement from an experienced engineer. Such judgement often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact us for further advice.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report.

The comments given in this report are intended only for the guidance of the design engineer, or for other purposes specifically noted in the report. The number of boreholes or test excavations necessary to determine all relevant underground conditions which may affect construction costs, techniques and equipment choice, scheduling, and sequence of operations would normally be greater than has been carried out for design purposes. Contractors should therefore rely on their own additional investigations, as well as their own interpretations of the borehole data in this report, as to how subsurface conditions may affect their work.

Should you have any queries relating to this report, please do not hesitate to contact the undersigned

Yours faithfully,
For and on behalf of
BHM Geotechnical Pty Ltd

Manney Bandara
Associate|Geotechnical Engineer

Reviewed By

Stephen Muscat
Associate|Geotechnical Engineer

This is the document described as

Appendix A

BHM Geotechnical
Level 17, 123 Pitt Street Sydney NSW 2000
Phone: (02) 8324 1412

Geotechnical Log - Borehole

01

UTM :
Easting (m) : 0.0
Northing (m) : 0.0
Ground Elevation : 10.81 (m)
Total Depth : 20 m BGL

Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 03/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment : -

Drilling Method	Water	Depth (m)	Elevation Depth (m)	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Samples DS	Testing SPT	Well Diagram
Solid Flight Auger		1	9.81	Fill	▩	CL-CI	Fill silty CLAY (CL-CI) : low to medium plasticity, brown, w ≈ pl.	w ≈ PL			2, 1, 1 (N = 2)	
		1.5	1 9.31	Alluvial	▨	CL-CI	Alluvial sandy CLAY (CL-CI) : stiff, low to medium plasticity, brown, w ≈ pl.	w ≈ PL	St		4, 5, 11 (N = 16)	
		2.5	1.5 8.31	Alluvial	▨	CL-CI	As above, grey mottled brown orange.	w ≈ PL	St			
		3.5	2.5 7.31000000	Residual	▨	CL-CI	Residual CLAY (CL-CI) : very stiff, low to medium plasticity, red, w ≈ pl.	w ≈ PL	VSt		5, 7, 13 (N = 20)	
		5	3.5 5.81000000	Residual	▨	CL-CI	As above, grey.	w ≈ PL	VSt		12, 17, 20 (N = 37)	
	▶—	6.5	5 4.31000000	Residual	▨	CL-CI	As above, red mottled grey.	w ≈ PL	VSt		8, 16, 21 (N = 37)	
			6.5	Residual	▧	CI-CH	As above, (CI-CH) : medium to high plasticity, with fine sized gravel, w > ll, (fine to medium, sub-angular, siltstone).	w > LL	VSt		25, 45 (N > 50) HB	

7.7m : Commenced NMLC Coring;

Water

- ▶— Water inflow
- —◀ Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

BHM Geotechnical
Level 17, 123 Pitt Street Sydney NSW 2000
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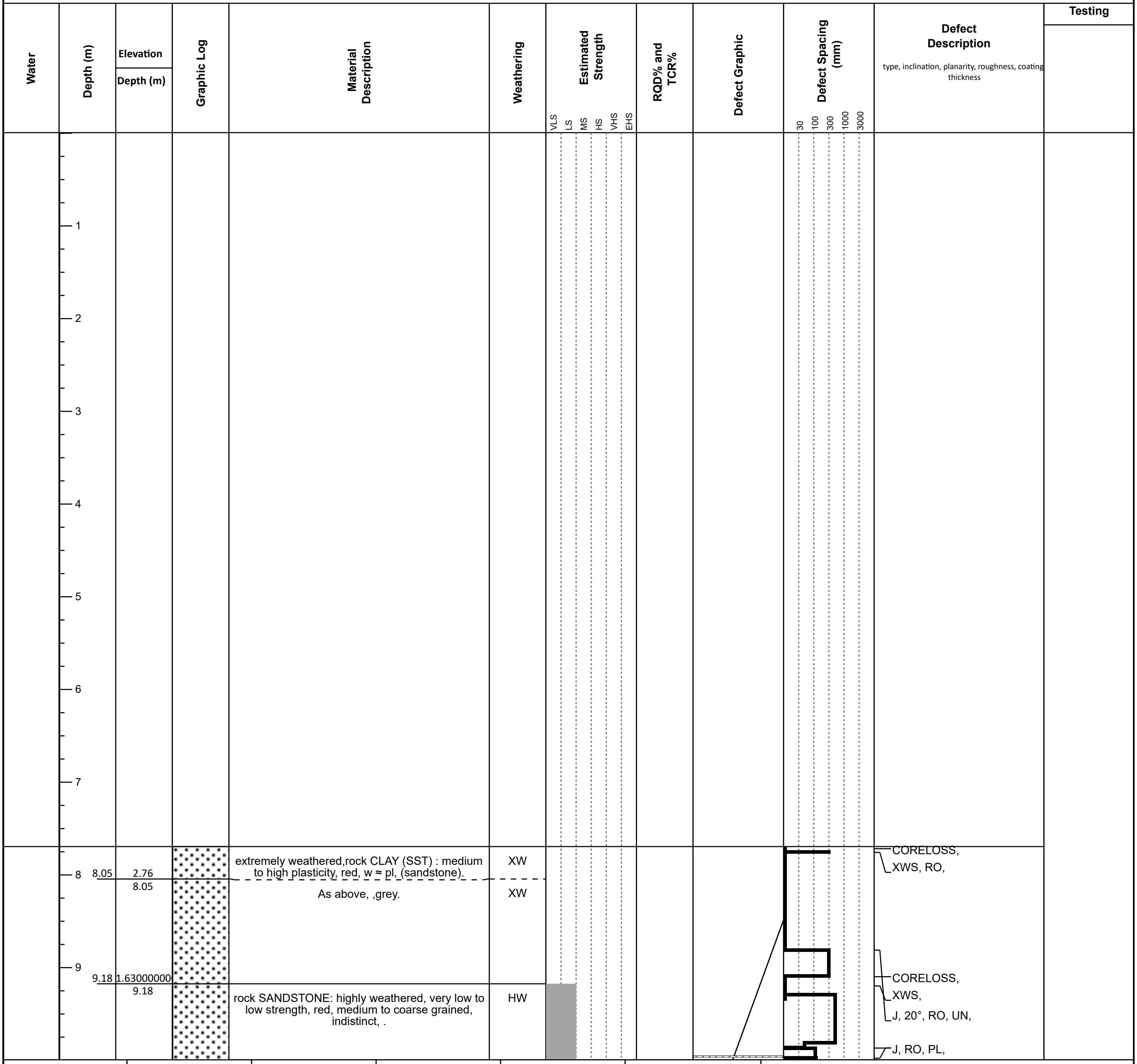
Geotechnical Log - Borehole
01

UTM :	**Drill Rig** : Hanjin	**Job Number** : CHP 2293
Easting (m) : 0.0	**Driller Supplier** : BG Drilling	**Client** : CHP Fund
Northing (m) : 0.0	**Logged By** : DZ	**Project** : Residential Development
Ground Elevation : 10.81 (m)	**Reviewed By** : MB	**Location** : 60 showground road, Gosford NSW
Total Depth : 20 m BGL	**Date** : 03/07/2023	**Loc Comment** : -



Water	Depth (m)	Elevation Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength	RQD% and TCR%	Defect Graphic	Defect Spacing (mm)	Defect Description type, inclination, planarity, roughness, coating thickness	Testing
	8.05	2.76 8.05		extremely weathered,rock CLAY (SST) : medium to high plasticity, red, w ≈ pl, (sandstone).	XW					CORELOSS, XWS, RO,	
				As above, ,grey.	XW						
	9.18	1.63000000 9.18		rock SANDSTONE: highly weathered, very low to low strength, red, medium to coarse grained, indistinct, .	HW					CORELOSS, XWS, J, 20°, RO, UN, J, RO, PL,	

Water
▶ Water inflow
◀ Water outflow
▼ ▽ Ground water Level during drilling

Weathering
XW : Extremely weathered
DW : Distinctly weathered
HW : Highly weathered
MW : Moderately weathered
SW : Slightly weathered
FR : Fresh

Altering
XA : Extremely alterated
DA : Distinctly alterated
HA : Highly alterated
MA : Moderately alterated
SA : Slightly alterated

Consistency
VS : Very soft
S : Soft
F : Firm
St : Stiff
VSt : Very stiff
H : Hard
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Moisture
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VL : Very loose
L : Loose
MD : Medium dense
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Rock Strength
VLS : Very low
LS : Low
MS : Medium
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XH : Extremely high

Tests&Results
U50 : Undisturbed 50mm diam tube.
D : Disturbed sample.
SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
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BHM Geotechnical
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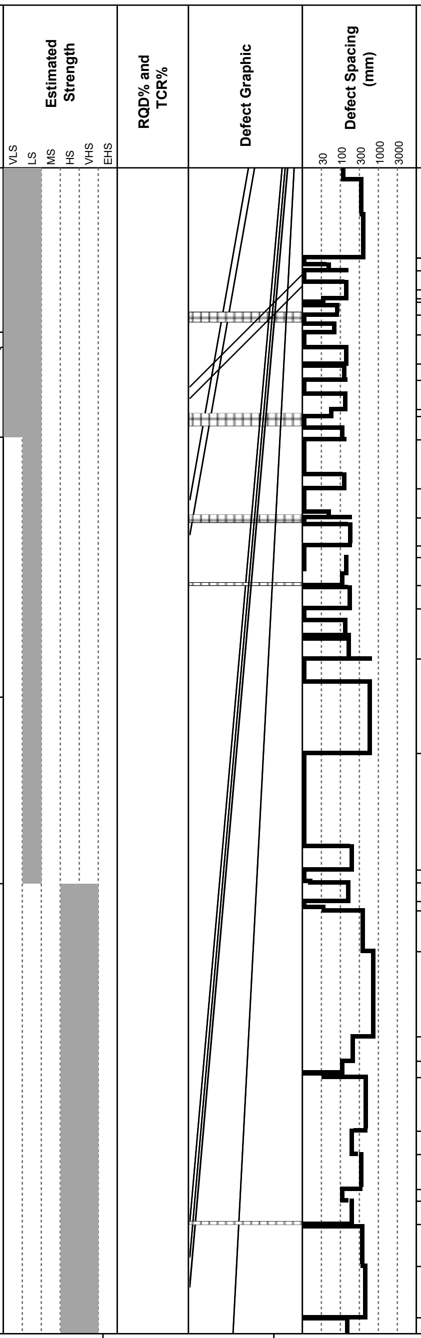
Phone: (02) 8324 1412

Geotechnical Log - Borehole
01

UTM	:	**Drill Rig**	: Hanjin	**Job Number**	: CHP 2293
Easting (m)	: 0.0	**Driller Supplier**	: BG Drilling	**Client**	: CHP Fund
Northing (m)	: 0.0	**Logged By**	: DZ	**Project**	: Residential Development
Ground Elevation	: 10.81 (m)	**Reviewed By**	: MB	**Location**	: 60 showground road, Gosford NSW
Total Depth	: 20 m BGL	**Date**	: 03/07/2023	**Loc Comment**	: -

Depth (m)	Elevation	Depth (m)	Material Description	Weathering
			rock SANDSTONE: highly weathered, very low to low strength, red, medium to coarse grained, indistinct, .	HW
11.41	-0.59999999	11.41	As above, grey, distinct.	HW
11.54	-0.72999999	11.54	As above, red.	HW
12.31	-1.5	12.31	As above, moderately , low strength, red mottled grey.	MW
14.54	-3.72999999	14.54	rock SILTSTONE: highly weathered, low strength, grey, grained, indistinct, .	HW
16.14	-5.33	16.14	As above, fresh , high to very high strength, distinct.	F



Defect Description
type, inclination, planarity, roughness, coating thickness

J, 10°, SO, PL,
XWS, RO, PL,
CORELOSS,
J, SO, PL,
XWS, RO, PL,
CS, RO, PL,
J, 45°, SO, STP,
XWS, RO, PL,
XWS, RO, PL,
XWS, RO, PL,
J, SO, PL,
CS, RO, PL,
CORELOSS,
CORELOSS,
CS, RO, PL,
CORELOSS,
J, SO, PL,
CS, RO, PL,
J, 5°, SO, PL,
CORELOSS,
J, 5°, SO, PL,
CORELOSS,
J, 5°, SO, PL,
XWS, RO, PL,
XWS, RO, PL,
J, SO, PL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, 3°, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
J, PO, PL, CL,
CS,
J, PO, PL, CL,
J, PO, PL, CL,

Testing

Water
▶ Water inflow
◀ Water outflow
▼ Ground water Level
▽ during drilling

Weathering
XW : Extremely weathered
DW : Distinctly weathered
HW : Highly weathered
MW : Moderately weathered
SW : Slightly weathered
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Altering
XA : Extremely altered
DA : Distinctly altered
HA : Highly altered
MA : Moderately altered
SA : Slightly altered

Consistency
VS : Very soft
S : Soft
F : Firm
St : Stiff
VSt : Very stiff
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Density
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VD : Very dense

Rock Strength
VLS : Very low
LS : Low
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XH : Extremely high

Tests&Results
U50 : Undisturbed 50mm diam tube.
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S : Vane shear value kPa.
DCP : Dynamic Cone Penetrometer test.

BHM Geotechnical
Level 17, 123 Pitt Street Sydney NSW 2000
Phone: (02) 8324 1412

Geotechnical Log - Borehole
02

UTM	**: 56H**	**Drill Rig**	**: Hanjin**	**Job Number**	**: CHP 2293**
Easting (m)	**: 345789.7**	**Driller Supplier**	**: BG Drilling**	**Client**	**: CHP Fund**
Northing (m)	**: 6300783.7**	**Logged By**	**: DZ**	**Project**	**: Residential Development**
Ground Elevation	**: 11.94 (m)**	**Reviewed By**	**: MB**	**Location**	**: 60 showground road, Gosford NSW**
Total Depth	**: 19.8 m BGL**	**Date**	**: 04/07/2023**	**Loc Comment :**	

Drilling Method	Water	Depth (m)	Elevation Depth (m)	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Samples DS	Testing SPT	Well Diagram
Solid Flight Auger			0.3 11.639999999999999 0.3	Fill		CL-CI	Fill silty CLAY (CL-CI) : low to medium plasticity, brown mottled red, w ≈ pl.	w ≈ PL				A
		1	1 10.94 1	Fill		SM	Fill silty SAND (SM) : brown, fine to medium grained, moist.	M			11, 10, 7 (N = 17)	
		2	2 9.94 2	Alluvial		SC	Alluvial clayey SAND (SC) : medium dense, pale brown, fine to medium grained, moist.	M	MD		3, 5, 8 (N = 13)	
		3 4	4.7 7.2399999999999999 4.7	Residual		CL-CI	Residual CLAY (CL-CI) : hard, low to medium plasticity, red, w ≈ pl.	w ≈ PL	H		9, 18, 15 (N = 33)	
		5	5.5 6.4399999999999995 5.5	Residual		CL-CI	Residual CLAY (CL-CI) : hard, low to medium plasticity, grey, w ≈ pl.	w ≈ PL	H		9, 19, 22 (N = 41)	
	▶	6 7	7 4.9399999999999995 7	Residual		CL-CI	As above, red mottled grey.	w ≈ PL	H		10, 17, 18 (N = 35)	
		8 9		Residual		CI-CH	Residual CLAY (CI-CH) : hard, medium to high plasticity, grey, w ≈ pl, (with sandstone bands).	w ≈ PL	H		17, 28, 44 (N > 50)	
		10 11 12 13 14 15 16 17 18 19					**9m : Commenced NMLC Coring;**					

Water
▶ Water inflow
◀ Water outflow
Ground water Level during drilling

Weathering
XW : Extremely weathered
DW : Distinctly weathered
HW : Highly weathered
MW : Moderately weathered
SW : Slightly weathered
FR : Fresh

Altering
XA : Extremely altered
DA : Distinctly altered
HA : Highly altered
MA : Moderately altered
SA : Slightly altered

Consistency
VS : Very soft
S : Soft
F : Firm
St : Stiff
VSt : Very stiff
H : Hard
FR : Friable

Moisture
D : Dry
M : Moist
W : Wet

Density
VL : Very loose
L : Loose
MD : Medium dense
D : Dense
VD : Very dense

Rock Strength
VLS : Very low
LS : Low
MS : Medium
HS : High
VH : Very high
XH : Extremely high

Tests&Results
U50 : Undisturbed 50mm diam tube.
D : Disturbed sample.
SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
PP : Hand penetrometer estimate of unconfined compressive strength, kPa.
S : Vane shear value kPa.
DCP : Dynamic Cone Penetrometer test.

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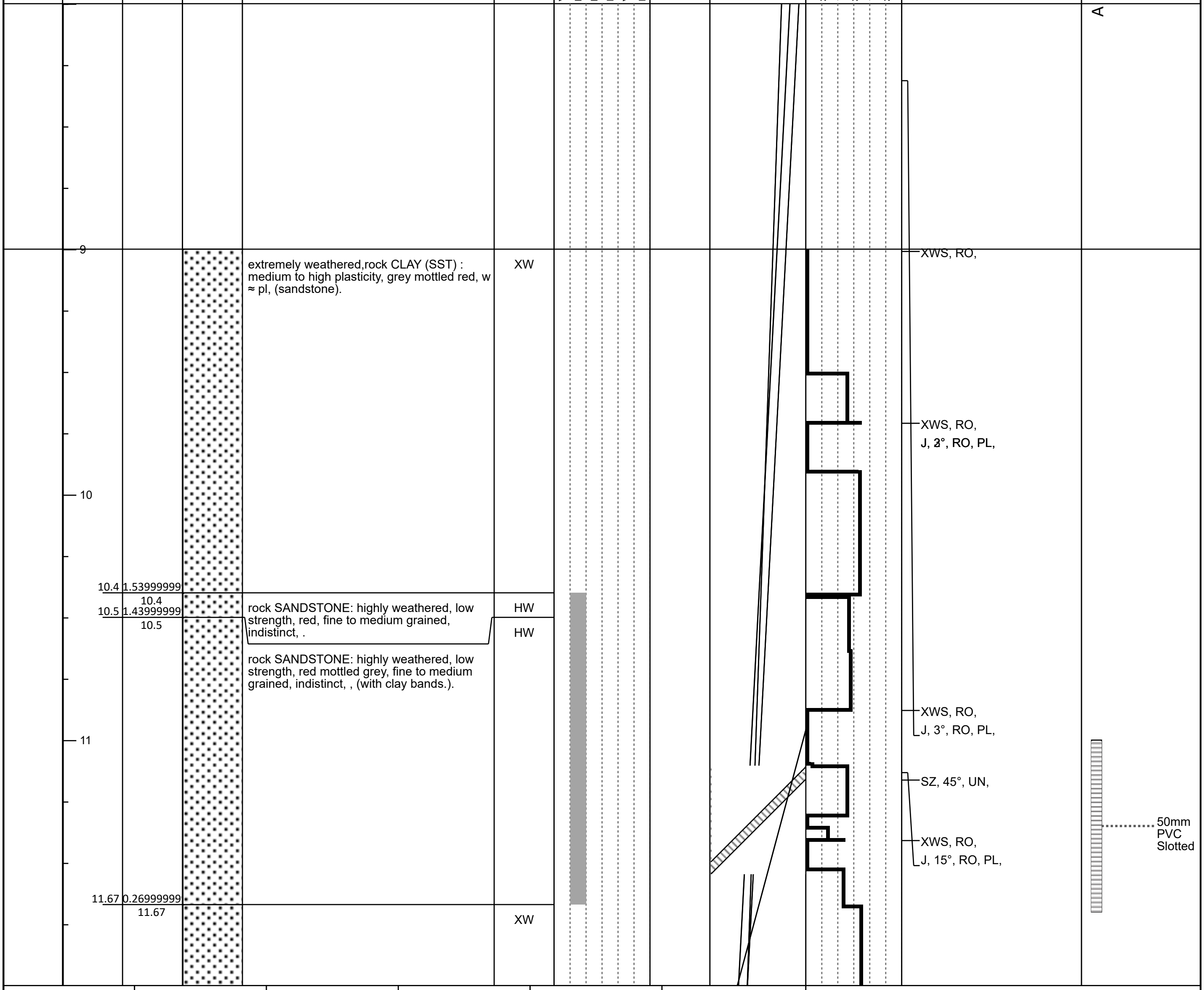
Geotechnical Log - Borehole
02

UTM : 56H
Easting (m) : 345789.7
Northing (m) : 6300783.7
Ground Elevation : 11.94 (m)
Total Depth : 19.8 m BGL

Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 04/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment :



Water	Depth (m)	Elevation Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength VLS LS MS HS VHS EHS	RQD% and TCR%	Defect Graphic	Defect Spacing (mm) 30 100 300 1000 3000	Defect Description type, inclination, planarity, roughness, coating thickness	Well Diagram
											A
	9			extremely weathered,rock CLAY (SST) : medium to high plasticity, grey mottled red, w ≈ pl, (sandstone).	XW					XWS, RO,	
										XWS, RO, J, 3°, RO, PL,	
	10										
	10.4	1.53999999 10.4		rock SANDSTONE: highly weathered, low strength, red, fine to medium grained, indistinct, .	HW						
	10.5	1.43999999 10.5		rock SANDSTONE: highly weathered, low strength, red mottled grey, fine to medium grained, indistinct, , (with clay bands.).	HW					XWS, RO, J, 3°, RO, PL,	
	11										
										SZ, 45°, UN,	
										XWS, RO, J, 15°, RO, PL,	50mm PVC Slotted
	11.67	0.26999999 11.67			XW						

Water
▶ Water inflow
◀ Water outflow
▼ Ground water Level
▽ during drilling

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Rock Strength
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U50 : Undisturbed 50mm diam tube.
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DCP : Dynamic Cone Penetrometer test.

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Geotechnical Log - Borehole

02

UTM : 56H
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Ground Elevation : 11.94 (m)
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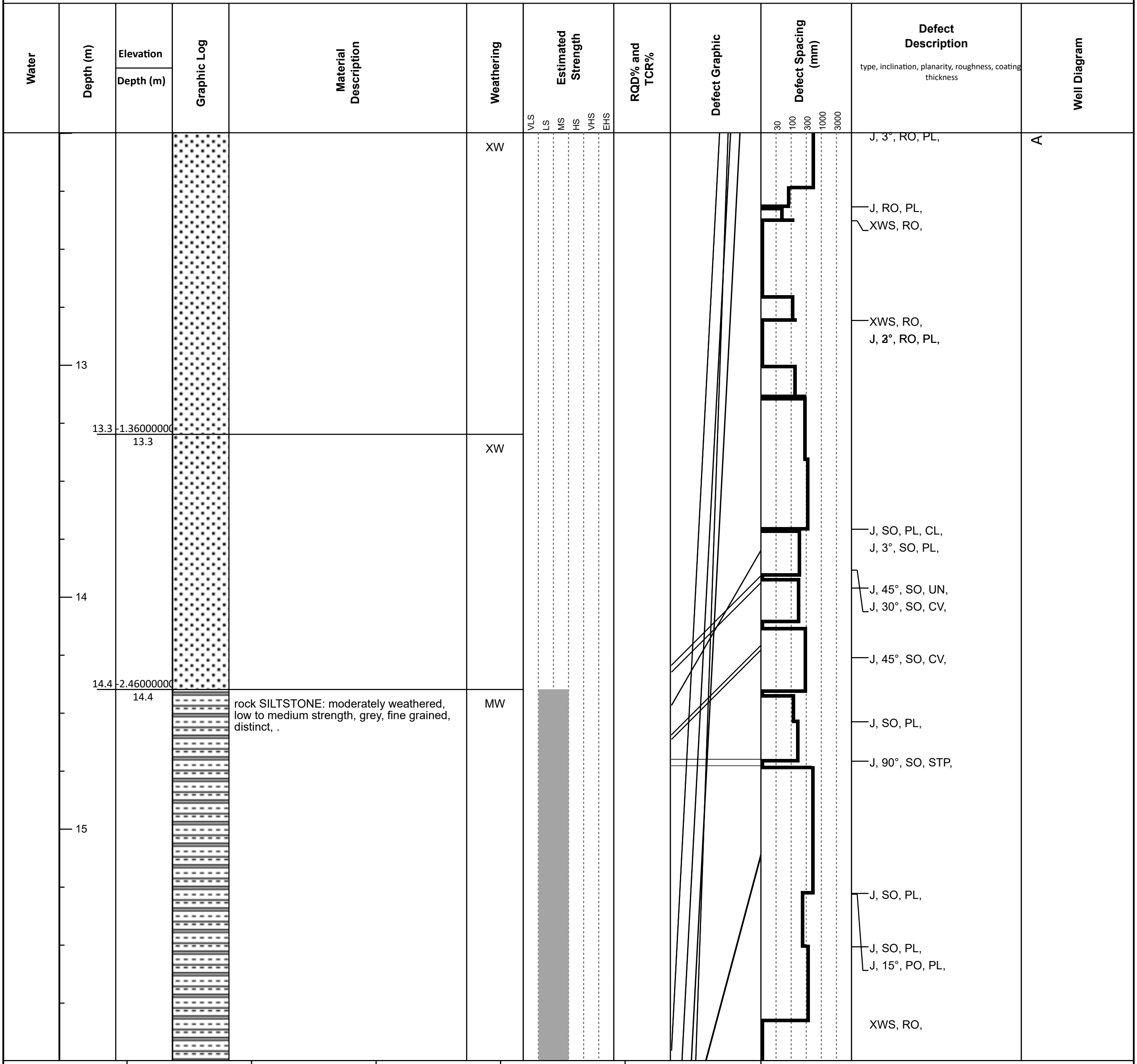
Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 04/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment :



rock SILTSTONE: moderately weathered, low to medium strength, grey, fine grained, distinct, .

Water
- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering
- **XW** : Extremely weathered
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- **HW** : Highly weathered
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- **SW** : Slightly weathered
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Altering
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Tests&Results
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Geotechnical Log - Borehole
02

UTM : 56H
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Ground Elevation : 11.94 (m)
Total Depth : 19.8 m BGL

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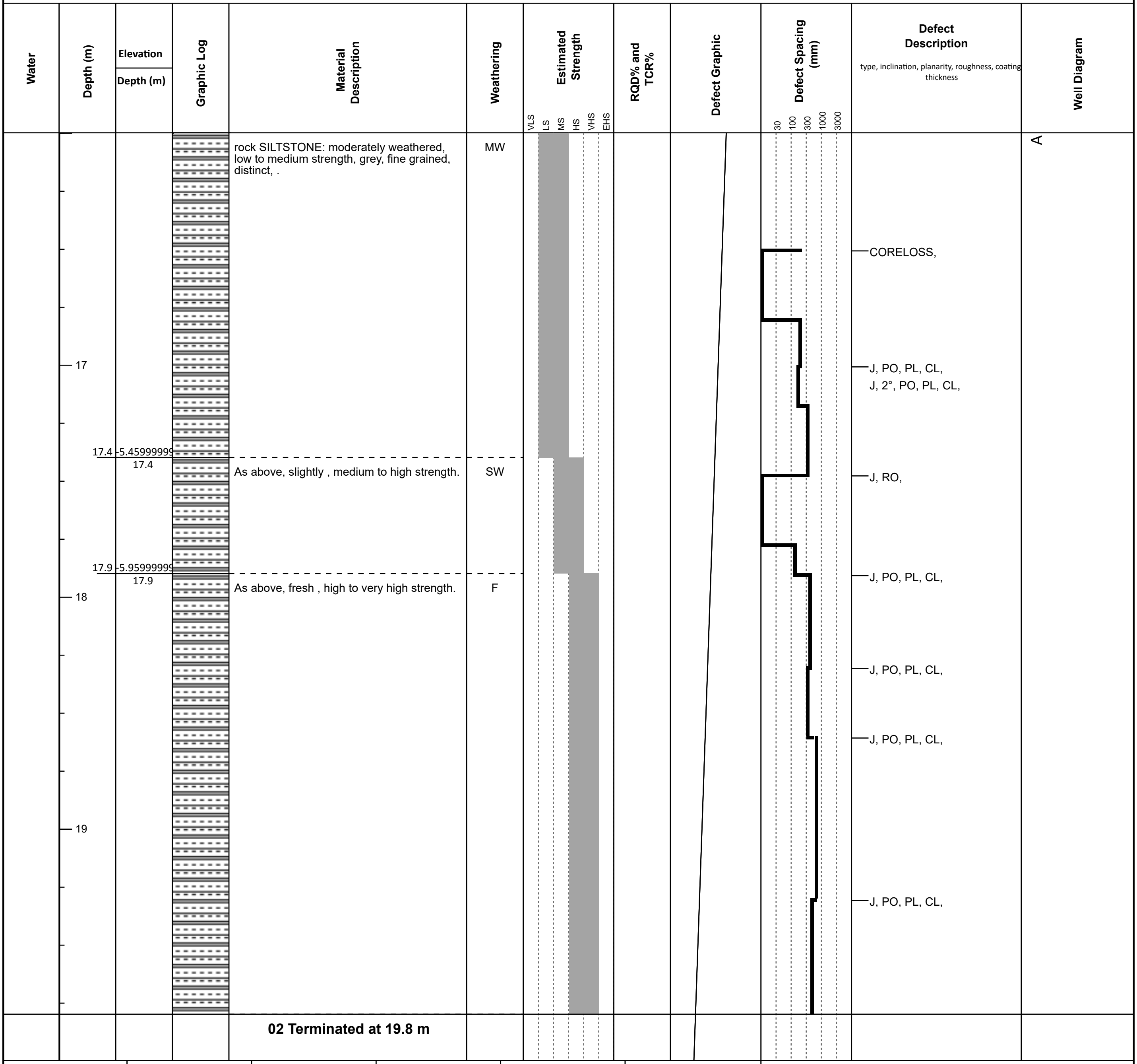
Date : 04/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment :



Elevation / Depth (m)	Material Description	Weathering
	rock SILTSTONE: moderately weathered, low to medium strength, grey, fine grained, distinct, .	MW
17.4 -5.45999999 17.4	As above, slightly , medium to high strength.	SW
17.9 -5.95999999 17.9	As above, fresh , high to very high strength.	F

Defect Description:
- CORELOSS,
- J, PO, PL, CL,
- J, 2°, PO, PL, CL,
- J, RO,
- J, PO, PL, CL,
- J, PO, PL, CL,
- J, PO, PL, CL,
- J, PO, PL, CL,

02 Terminated at 19.8 m

Water
- ▶ Water inflow
- ◀ Water outflow
- Ground water Level during drilling

Weathering
- XW : Extremely weathered
- DW : Distinctly weathered
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- MW : Moderately weathered
- SW : Slightly weathered
- FR : Fresh

Altering
- XA : Extremely alterated
- DA : Distinctly alterated
- HA : Highly alterated
- MA : Moderately alterated
- SA : Slightly alterated

Consistency
- VS : Very soft
- S : Soft
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- St : Stiff
- VSt : Very stiff
- H : Hard
- FR : Friable

Moisture
- D : Dry
- M : Moist
- W : Wet

Density
- VL : Very loose
- L : Loose
- MD : Medium dense
- D : Dense
- VD : Very dense

Rock Strength
- VLS : Very low
- LS : Low
- MS : Medium
- HS : High
- VH : Very high
- XH : Extremely high

Tests&Results
- U50 : Undisturbed 50mm diam tube.
- D : Disturbed sample.
- SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
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Geotechnical Log - Borehole
03

UTM :
Easting (m) : 0.0
Northing (m) : 0.0
Ground Elevation : 15.13 (m)
Total Depth : 20 m BGL

Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 05/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment :

Drilling Method	Water	Depth (m)	Elevation Depth (m)	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Consistency/Density	Samples	Testing	Well Diagram
										DS	SPT	
Solid Flight Auger			15.030000000000001 0.1	CONCRET								B
		1		Fill		CL-CI	Fill sandy CLAY (CL-CI) : low to medium plasticity, brown, fine grained sand, w ≈ pl.	w ≈ PL			4, 9, 13 (N = 22)	
		1.5 2	13.63 1.5	Alluvial		CL-CI	Alluvial CLAY (CL-CI) : very stiff, low to medium plasticity, red mottled brown, w < pl.	w < PL	VSt		10, 14, 16 (N = 30)	50mm PVC Slotte
		3	12.13 3	Residual		CL-CI	Residual CLAY (CL-CI) : hard, low to medium plasticity, grey mottled red, w < pl.	w < PL	H		10, 22, 48 (N > 50)	
	▶	4	11.13 4	Rock		SST	Extremely weathered,rock CLAY (SST) : low to medium plasticity, grey, w < pl.	w < PL				
		5 6 7 8 9					**4.5m : Commenced NMLC Coring;**					

Water
▶ Water inflow
◀ Water outflow
Ground water Level during drilling

Weathering
XW : Extremely weathered
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FR : Fresh

Altering
XA : Extremely altered
DA : Distinctly altered
HA : Highly altered
MA : Moderately altered
SA : Slightly altered

Consistency
VS : Very soft
S : Soft
F : Firm
St : Stiff
VSt : Very stiff
H : Hard
FR : Friable

Moisture
D : Dry
M : Moist
W : Wet

Density
VL : Very loose
L : Loose
MD : Medium dense
D : Dense
VD : Very dense

Rock Strength
VLS : Very low
LS : Low
MS : Medium
HS : High
VH : Very high
XH : Extremely high

Tests&Results
U50 : Undisturbed 50mm diam tube.
D : Disturbed sample.
SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
PP : Hand penetrometer estimate of unconfined compressive strength, kPa.
S : Vane shear value kPa.
DCP : Dynamic Cone Penetrometer test.

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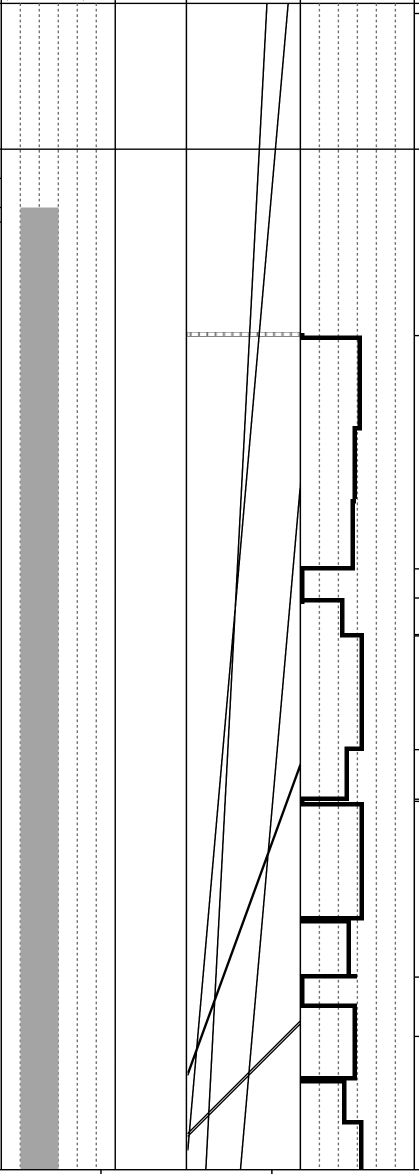
Geotechnical Log - Borehole
03

UTM	:	**Drill Rig**	: Hanjin	**Job Number**	: CHP 2293
Easting (m)	: 0.0	**Driller Supplier**	: BG Drilling	**Client**	: CHP Fund
Northing (m)	: 0.0	**Logged By**	: DZ	**Project**	: Residential Development
Ground Elevation	: 15.13 (m)	**Reviewed By**	: MB	**Location**	: 60 showground road, Gosford NSW
Total Depth	: 20 m BGL	**Date**	: 05/07/2023	**Loc Comment**	:

Water	Depth (m)	Elevation Depth (m)	Graphic Log	Material Description	Weathering
	4.6	10.5300000 4.6		extremely weathered,rock CLAY (SST) : low to medium plasticity, red, w ≈ pl.	XW
	4.7	10.43		As above, ,grey.	XW
	4.75	10.38 4.7 4.75		rock SANDSTONE: moderately weathered, low to medium strength, grey, fine to medium grained, .	MW
	5			As above, red mottled yellow grey, medium to coarse grained, distinct.	MW
	6				
	7				



Defect Description
type, inclination, planarity, roughness, coating thickness

- CS, RO,
- J, 5°, RO, PL,
- CORELOSS,
- J, RO, PL,
- J, RO, PL,
- J, RO, PL,
- XWS, RO,
- J, 20°, RO, PL,
- XWS, RO,
- J, 45°, RO, UN,
- J, 5°, RO, PL,

Testing

Water
- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering
XW	:	Extremely weathered
DW	:	Distinctly weathered
HW	:	Highly weathered
MW	:	Moderately weathered
SW	:	Slightly weathered
FR	:	Fresh

Altering
XA	:	Extremely altered
DA	:	Distinctly altered
HA	:	Highly altered
MA	:	Moderately altered
SA	:	Slightly altered

Consistency
VS	:	Very soft
S	:	Soft
F	:	Firm
St	:	Stiff
VSt	:	Very stiff
H	:	Hard
FR	:	Friable

Moisture
D	:	Dry
M	:	Moist
W	:	Wet

Density
VL	:	Very loose
L	:	Loose
MD	:	Medium dense
D	:	Dense
VD	:	Very dense

Rock Strength
VLS	:	Very low
LS	:	Low
MS	:	Medium
HS	:	High
VH	:	Very high
XH	:	Extremely high

Tests&Results
U50	:	Undisturbed 50mm diam tube.
D	:	Disturbed sample.
SPT	:	Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
PP	:	Hand penetrometer estimate of unconfined compressive strength, kPa.
S	:	Vane shear value kPa.
DCP	:	Dynamic Cone Penetrometer test.

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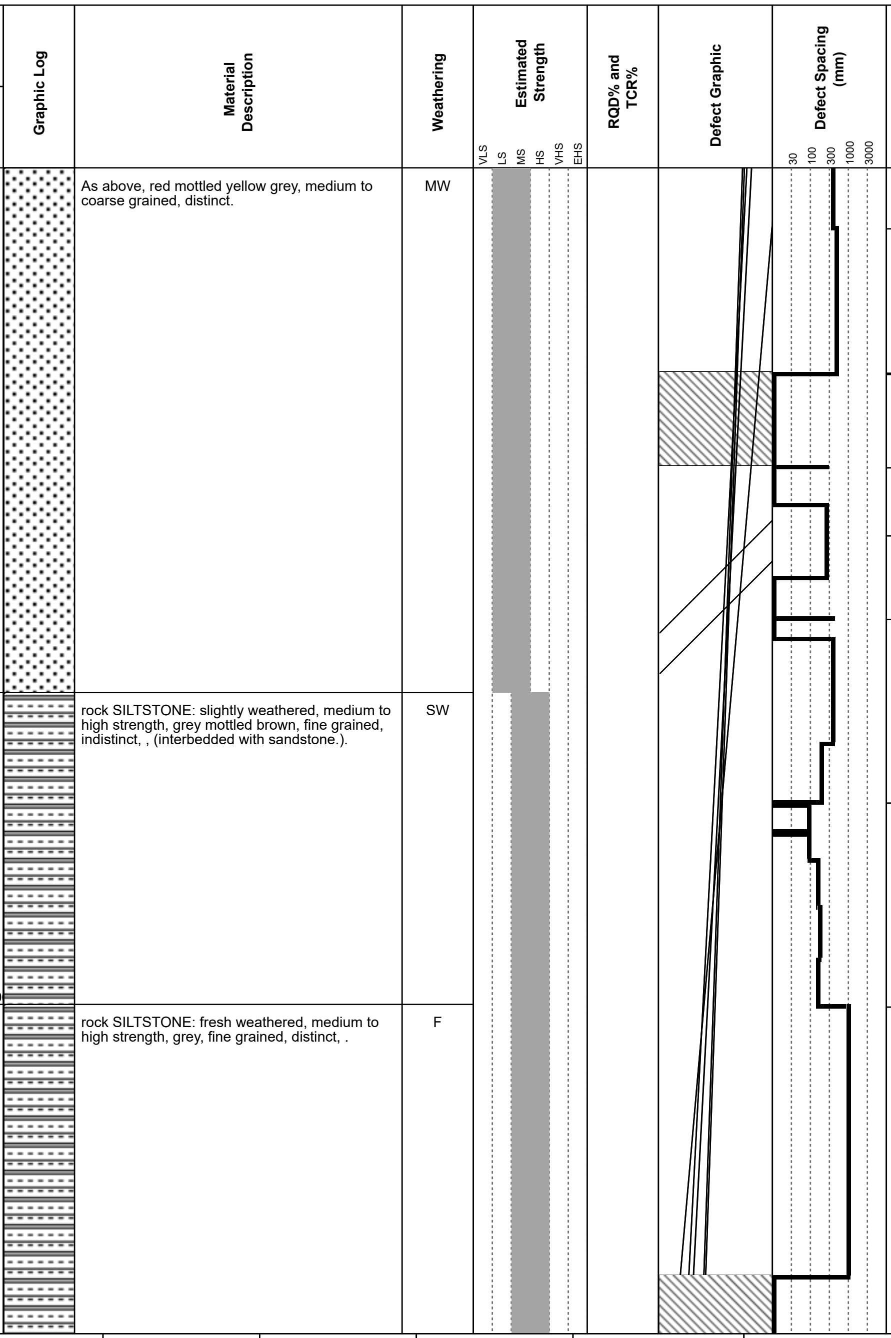
Geotechnical Log - Borehole

03

UTM	:	**Drill Rig**	: Hanjin	**Job Number**	: CHP 2293
Easting (m)	: 0.0	**Driller Supplier**	: BG Drilling	**Client**	: CHP Fund
Northing (m)	: 0.0	**Logged By**	: DZ	**Project**	: Residential Development
Ground Elevation	: 15.13 (m)	**Reviewed By**	: MB	**Location**	: 60 showground road, Gosford NSW
Total Depth	: 20 m BGL	**Date**	: 05/07/2023	**Loc Comment**	:

Water	Depth (m)	Elevation Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength	RQD% and TCR%	Defect Graphic	Defect Spacing (mm)	Defect Description type, inclination, planarity, roughness, coating thickness	Testing
	9			As above, red mottled yellow grey, medium to coarse grained, distinct.	MW					J, RO, PL, SZ, RO, XWS, RO, J, 45°, RO, UN, CORELOSS, J, 3°, RO, PL,	
	9.8 10	5.33 9.8		rock SILTSTONE: slightly weathered, medium to high strength, grey mottled brown, fine grained, indistinct, , (interbedded with sandstone.).	SW					J, RO, PL, J, 5°, RO, PL, J, 2°, SO, PL,	
	10.87 11	4.26000000 10.87		rock SILTSTONE: fresh weathered, medium to high strength, grey, fine grained, distinct, .	F					J, SO, PL, SZ, RO,	



Water
- ▶ Water inflow
- ◀ Water outflow
- ▼ Ground water Level
- ▽ during drilling

Weathering
- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering
- **XA** : Extremely altered
- **DA** : Distinctly altered
- **HA** : Highly altered
- **MA** : Moderately altered
- **SA** : Slightly altered

Consistency
- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture
- **D** : Dry
- **M** : Moist
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Density
- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength
- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
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Tests&Results
- **U50** : Undisturbed 50mm diam tube.
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Geotechnical Log - Borehole
03

UTM :
Easting (m) : 0.0
Northing (m) : 0.0
Ground Elevation : 15.13 (m)
Total Depth : 20 m BGL

Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 05/07/2023

Job Number : CHP 2293
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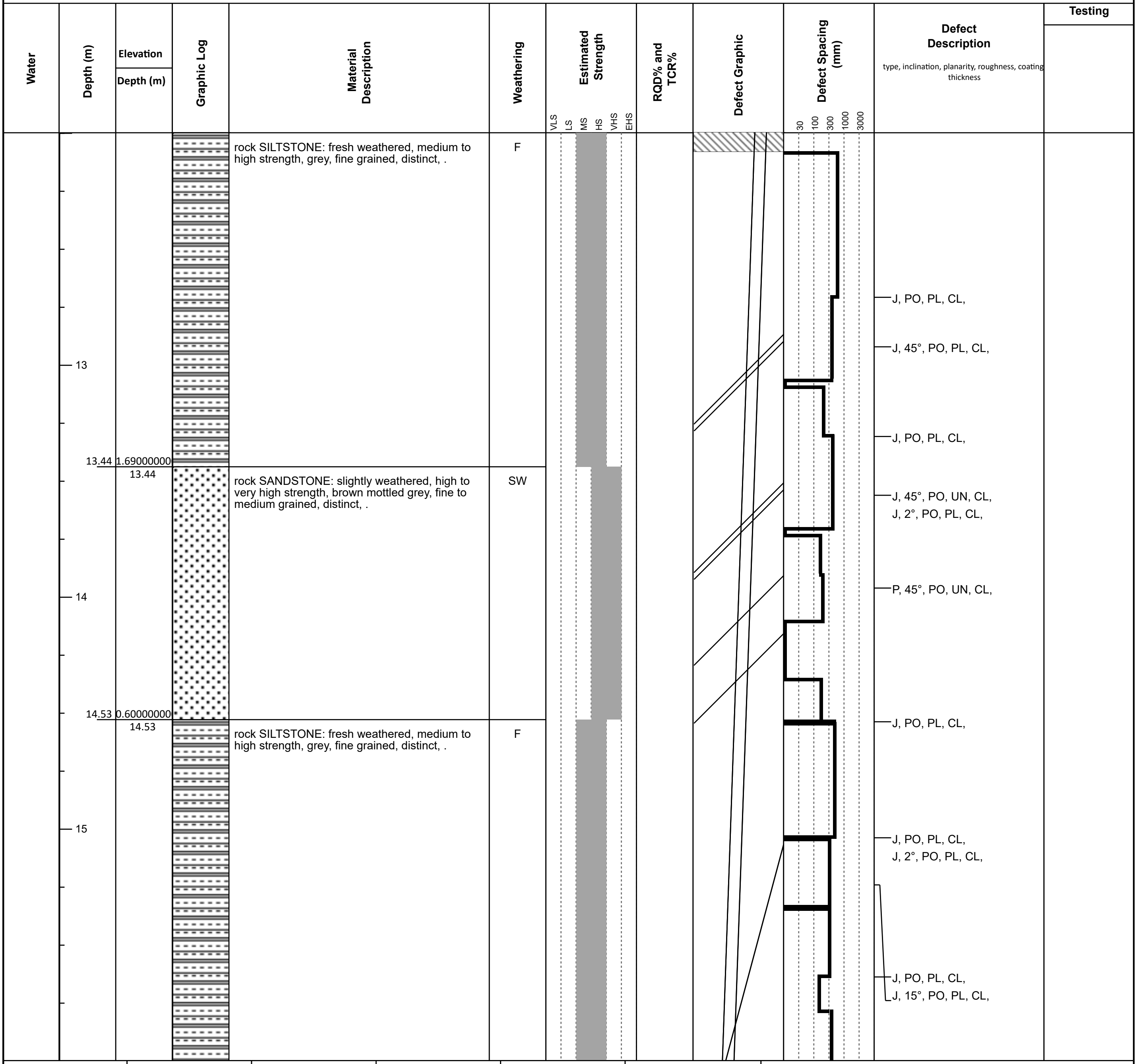

Water	Depth (m)	Elevation Depth (m)	Material Description	Weathering	Defect Description type, inclination, planarity, roughness, coating thickness	Testing
	13		rock SILTSTONE: fresh weathered, medium to high strength, grey, fine grained, distinct, .	F	J, PO, PL, CL, J, 45°, PO, PL, CL, J, PO, PL, CL,	
	14	13.44 1.69000000 13.44	rock SANDSTONE: slightly weathered, high to very high strength, brown mottled grey, fine to medium grained, distinct, .	SW	J, 45°, PO, UN, CL, J, 2°, PO, PL, CL, P, 45°, PO, UN, CL,	
	15	14.53 0.60000000 14.53	rock SILTSTONE: fresh weathered, medium to high strength, grey, fine grained, distinct, .	F	J, PO, PL, CL, J, PO, PL, CL, J, 2°, PO, PL, CL, J, PO, PL, CL, J, 15°, PO, PL, CL,	

Water
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Rock Strength
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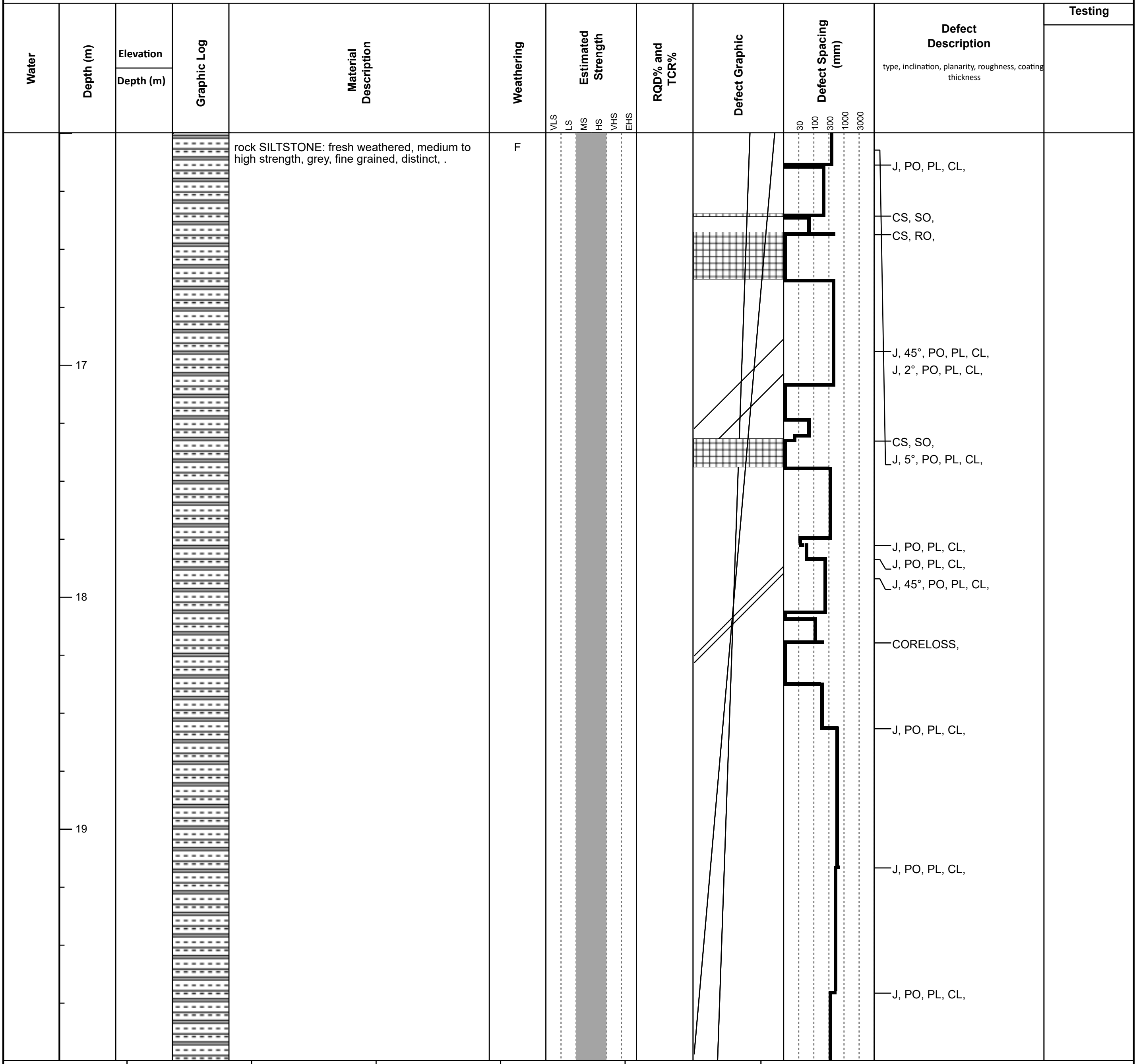
Geotechnical Log - Borehole

03

UTM :
Easting (m) : 0.0
Northing (m) : 0.0
Ground Elevation : 15.13 (m)
Total Depth : 20 m BGL

Drill Rig : Hanjin
Driller Supplier : BG Drilling
Logged By : DZ
Reviewed By : MB
Date : 05/07/2023

Job Number : CHP 2293
Client : CHP Fund
Project : Residential Development
Location : 60 showground road, Gosford NSW
Loc Comment :



rock SILTSTONE: fresh weathered, medium to high strength, grey, fine grained, distinct, .

Weathering: F

Defect Description:
- J, PO, PL, CL,
- CS, SO,
- CS, RO,
- J, 45°, PO, PL, CL,
- J, 2°, PO, PL, CL,
- CS, SO,
- J, 5°, PO, PL, CL,
- J, PO, PL, CL,
- J, PO, PL, CL,
- J, 45°, PO, PL, CL,
- CORELOSS,
- J, PO, PL, CL,
- J, PO, PL, CL,
- J, PO, PL, CL,

Water

- ▶ Water inflow
- ◀ Water outflow
- ▼ Ground water Level during drilling

Weathering

- XW : Extremely weathered
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Altering

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Tests&Results

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This is the document described as

Appendix B

Report Explanation Notes

Introduction

These notes have been provided to accompany the geotechnical report with regard to classification methods, field procedures and certain matters relating to the comments and recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which varies from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties to understand or predict the behaviour of the ground at a particular site under certain conditions. This report contains such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directed relevant only to the ground at the place where and time when investigation was carried out.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726 - 2017 *"Geotechnical Site Investigations"*. In general, descriptions cover the following properties – soil/rock type, colour, structure, strength/density and inclusions. Identifications and classification of soil and rock involves judgement and infers accuracy only to the extent that is common in current geotechnical practice.

Soil Classification	**Particle Size**
Clay	Less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2 mm
Gravel	2 to 60 mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	**SPT "N" Value (blows/300mm)**
Very Loose	Less than 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	**Unconfined Compressive Strength (kPa)**
Very Soft	Less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable -Soil Crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report.

Sampling

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture, minor constituents and depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50 mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

Investigation Methods

The following is a brief summary of investigation methods currently adopted by BHM and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits

These are normally excavated with a backhoe or tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. Limitations of test pits are the problems associated with reinstatement and the consequent effects on close-by structures. Care must be taken if the construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling

A borehole of 50 mm to 100 mm diameter is advanced by manually operated equipment. Premature refusal of the hand auger can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers

The borehole is advanced using 75 mm to 155 mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger samples (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively low reliability due to the mixing or softening of samples by auguring, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even less reliability than augering above the watertable. Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments.

Wash Boring

The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling

Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliability of identification is only possible from the intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling

A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple core barrel of about 50 mm diameter is usually used with water flush. The length of the core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The locations of losses are to be determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Test

Standard Penetration Tests (SPT) are mainly used in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also obtain a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1 - 2004 *"Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - Standard penetration test (SPT)."*

The test is carried out in a borehole by driving a 50 mm diameter split sample tube with a tapered shoe, under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the "N" value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock the full 450 mm penetration may not be practical and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4,6,7 blows as:
  N = 13
  4, 6, 7
- In a case where the test was discontinued short of full penetration say after 15 blows for the first 150mm and 30 blows for the next 40 mm as
  N > 30
  15, 30/40 mm

The result of the test can be related empirically to the engineering properties of the soil.

Occasionally the drop hammer is used to drive 500 mm diameter thin walled tube samples (U50) in clays. In such circumstances the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clay, loose sands or where damage would otherwise be caused to the SPT equipment. The results of this Solid Cone Penetration Test (SCPT) are shown as “No” on the borehole logs together with the number of blows per 150mm penetration.

Portable Dynamic Cone Penetrometers

Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer {commonly known as the Scala Penetrometer} – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289.6.3.2 -1997 *“Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - 9kg dynamic cone penetrometer test”*. The test was developed initially for pavement subgrade investigations and correlations of the test results with California Bearing Ratio have been published by various Roads Authorities.
- Perth Sand Penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS 1289.6.3.3 -1997 *“Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - Perth sand penetrometer test”*. This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

Logs

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

The attached explanatory notes define the terms and symbol used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than “straight line” variations between boreholes and test pits. Subsurface conditions between the boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

Groundwater

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud be washed out of the hole or “reverted” chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to weeks for low permeability soils. Piezometers sealed in a particular stratum may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

Fill

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill material will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill material is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

Laboratory Testing

Laboratory testing is normally carried out in accordance with Australian Standard 1289 “Methods of Testing Soil for Engineering Purposes”. Details of the test procedure used are given on the individual report forms.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards for interpretation and analysis. Where the report has been prepared for a specific design proposal (e.g. a 3-storey building) the information and interpretation may not be relevant if the design proposal is changed (e.g. to a 20-storey building). In this event the BHM will be able to review the report and sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes to engineering codes and standards

If these occur BHM will be able to assist with investigation or provide advice to resolve any problems occurring.

Site Anomalies

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

Reproduction of Information for Contractual Purposes

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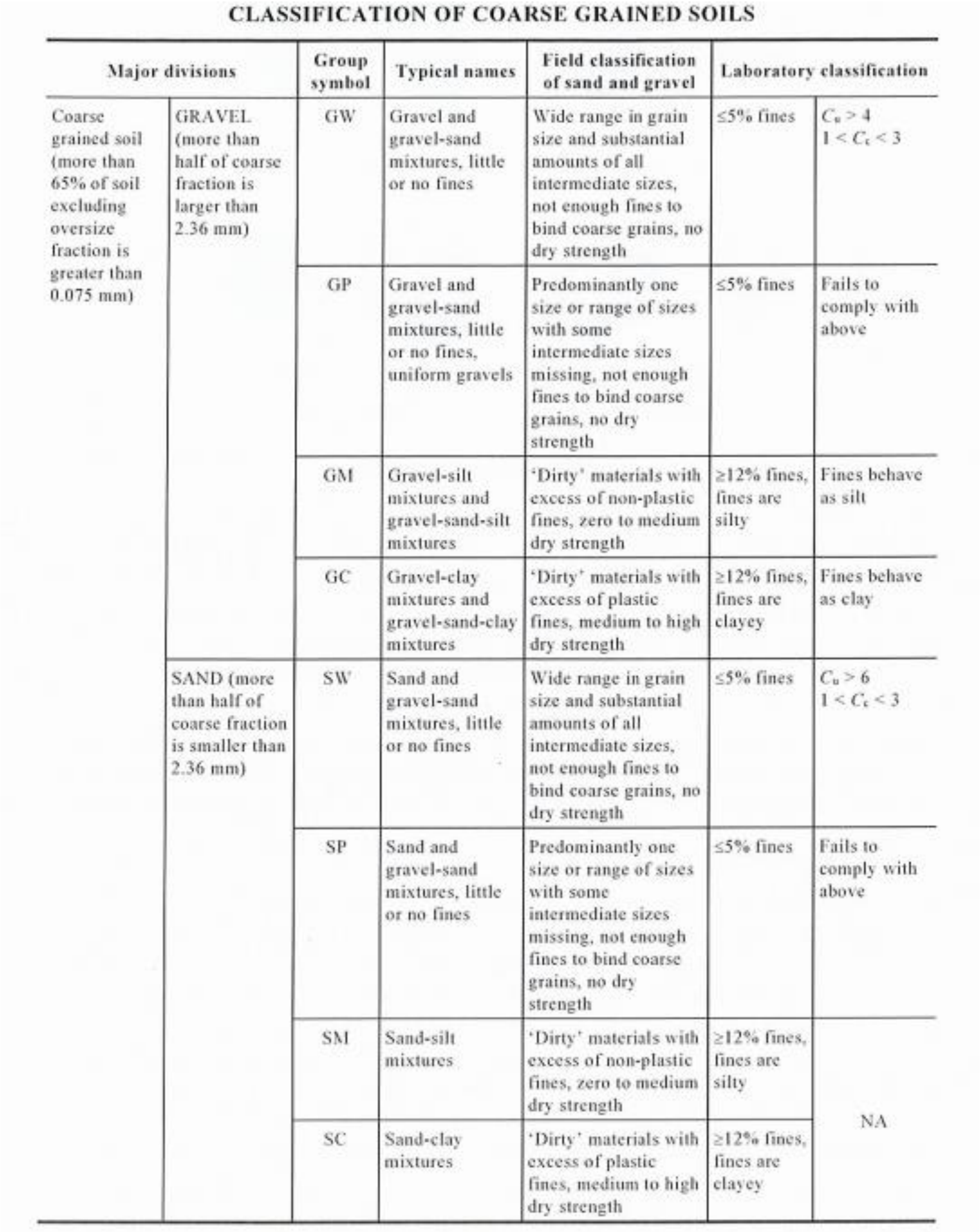
Site Inspection

BHM will always be able to provide engineering inspection services for geotechnical aspects of work to which this report is related. Requirements could range from:

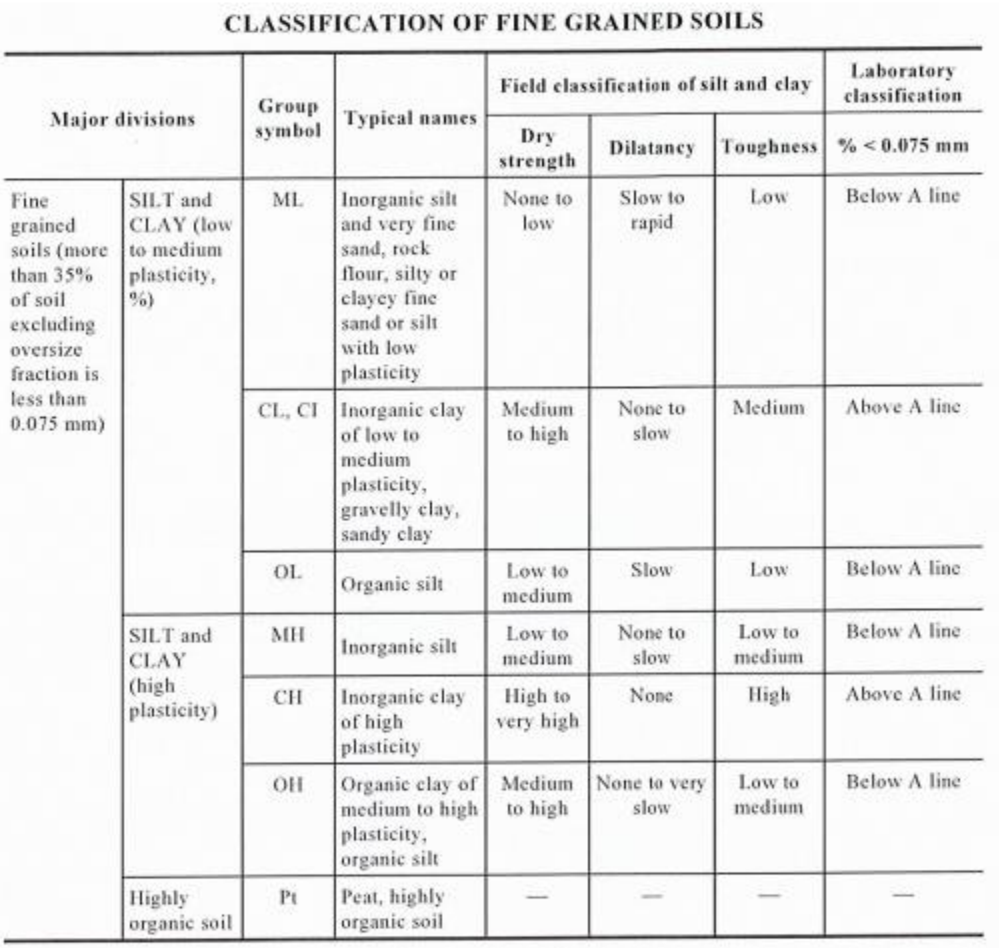
I. A site visit to confirm that conditions exposed are no worse than those interpreted.
II. A visit to assist the contractor or other site personnel in identifying changes to soil/rock types such as appropriate footing/pier founding depths, or;
III. Full time engineering presence on site.

TABLE A1
GUIDE TO THE DESCRIPTION IDENTIFICATION AND CLASSIFICATION OF SOILS



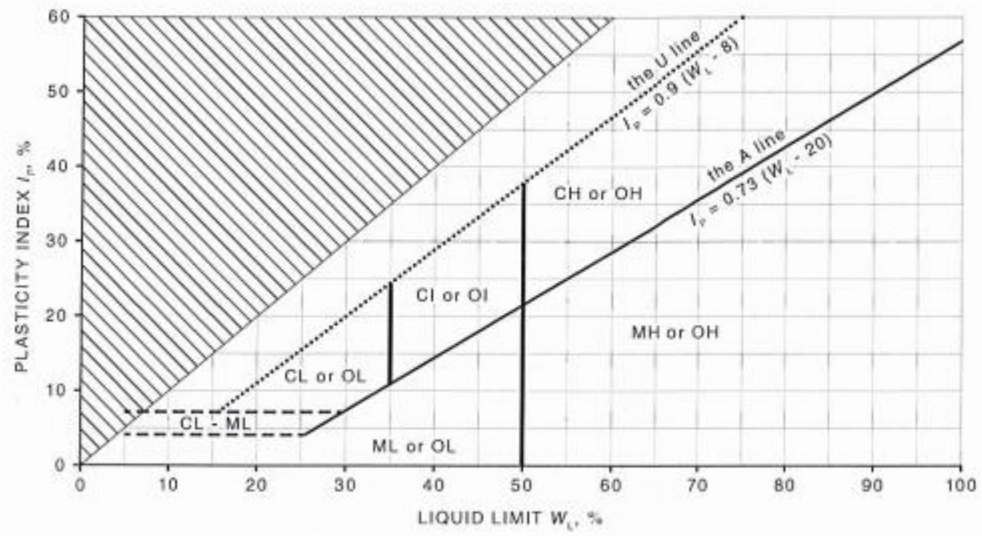
CLASSIFICATION OF COARSE GRAINED SOILS

Major divisions		Group symbol	Typical names	Field classification of sand and gravel	Laboratory classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075 mm)	GRAVEL (more than half of coarse fraction is larger than 2.36 mm)	GW	Gravel and 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% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and 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% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36 mm)	SW	Sand and 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% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥12% fines, fines are silty	NA
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayey	



CLASSIFICATION OF FINE GRAINED SOILS

Major divisions		Group symbol	Typical names	Field classification of silt and clay			Laboratory classification
				Dry strength	Dilatancy	Toughness	% < 0.075 mm
Fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075 mm)	SILT and CLAY (low to medium plasticity, %)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	—	—	—	—



NOTE: The U line is an approximate upper bound for most natural soils. Data which plot above the U line may represent unusual/problem soil behaviour, or unreliable data and should be considered carefully.

LOG SYMBOLS

Rock Material Weathering Classification

Term	Symbol	Definition
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in the volume but the soil has not been significantly transported.
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has “soil” properties, i.e. it either disintegrates or can be remoulded, in water.
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually be iron staining. Porosity may be increased by leaching or may be decreased due to disposition of weathering product in pores.
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.

Rock Strength

Rock strength is defined by the Point Load Strength Index (*Is 50*) and refers to the strength of the rock substance in the direction normal to the bedding. The method of measuring the point load strength index is accordance with AS 4133.4.1 – 2007 *“Methods of testing rocks for engineering purposes - Rock strength tests - Determination of point load strength index*

Term	Symbol	(Is 50) MPa	Field Guide
Very Low	VL	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.
Low	L	0.3	A piece of core 150mm x 50mm diameter may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium Strength	M	1	A piece of core 150mm x 50mm diameter can be broken by hand with difficulty. Readily scored with knife.
High	H	3	A piece of core 150mm x 50mm diameter cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
Very High	VH	10	A piece of core 150mm x 50mm diameter may be broken with hand-held pick after more than one blow. Cannot be scratched with penknife; rock rings under hammer.
Extremely High	EH	>10	A piece of core 150mm x 50mm diameter is difficult to break with a hand-held hammer. Rings when struck with a hammer.

Rock Quality Designation

Rock-quality designation (RQD) is a rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 100 mm or more. It is the borehole core recovery percentage incorporating only pieces of solid core that are longer than 100 mm in length measured along the centreline of the core. If the core is broken by drilling or handling then the broken pieces are fitted back together and are not included in the calculation of RQD.

The Rock Quality Designation (RQD) index is defined as:

$$RQD\ \% = \frac{Cumulative\ length\ of\ \ 'sound' coresections \geq 100\ mm\ long}{Total\ drilled\ length\ of\ section\ being\ assessed}$$

Rock Quality Designation

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes (mm)
Thinly laminated	< 6
Laminated	6 to 20
Very thinly bedded	20 to 60
Thinly bedded	60 to 200
Medium bedded	200 to 600
Thickly bedded	600 to 2000
Very thickly bedded	> 2000

Abbreviations Used in Defect Description

Abbreviation	Description	Notes
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (i.e. relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

Log Column	Symbol	Definition
Groundwater Record	▼ —C— ▶—	Standing water level. Time delay following completion of drilling may be shown. Extend of boreholes collapse shortly after drilling. Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES U50 B DS	Soil sample taken over depth indicated for environmental analysis. Undisturbed 50mm diameter tube sample taken over depth indicated. Bulk disturbed sample taken over depth indicated. Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (STP) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below
	Nc = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60-degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
Moisture Condition (Cohesive Soils)	MC>PL PM=PL MC<PL	Moisture content estimated to be greater than plastic limit. Moisture content estimated to by approximately equal to plastic limit. Moisture content estimated to be less than plastic limit.
(Cohesion less Soils)	D M W	DRY - runs freely through fingers. MOIST – does not run freely but free of water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S	VERY SOFT - Unconfined compression strength less than 25 kPa. SOFT - Unconfined compression strength 25-50 kPa.

	F	FIRM - Unconfined compression strength 50-100 kPa.		
	St	STIFF - Unconfined compression strength 100-200 kPa.		
	VSt	VERY STIFF - Unconfined compression strength 200-400 kPa.		
	H	HARD - Unconfined compression strength greater than 400 kPa.		
Density Index/ Relative Density (Cohesion Less Soils)		**Density Index (Ip)**	**Range (%)**	**SPT 'N' value range (Blows/300mm)**
	VL	Very Loose	<15	0-4
	L	Loose	15-35	4-10
	MD	Medium Density	35-65	10-30
	D	Dense	65-85	30-50
	VD	Very Dense	>85	>50
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.		
Remarks	'V' bit	Hardened steel 'V' shaped bit.		
	'TC' bit	Tungsten carbide wing bit.		
	HA	Hand Auger		
	T_{60}	Penetration of auger string in mm under static load of rig applied by drilled head hydraulics without rotation of auger.		

This is the document described as

Appendix C

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

PUBLISHING
BTF 18-2011
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

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

Saturation

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

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

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

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth

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

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

Unevenness of Movement

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

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

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

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

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

Effects of Uneven Soil Movement on Structures

Erosion and saturation

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

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

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

Seasonal swelling/shrinkage in clay

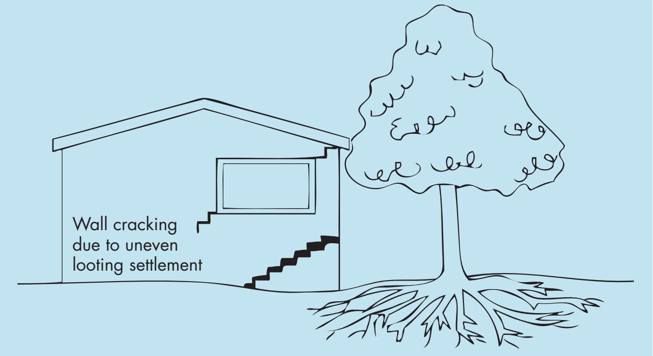
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the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

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

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

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

Trees can cause shrinkage and damage



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

Movement caused by tree roots

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

Complications caused by the structure itself

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

Effects on full masonry structures

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

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

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

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

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

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

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

Effects on brick veneer structures

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

Water Service and Drainage

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

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

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

Ground drainage

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

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

Protection of the building perimeter

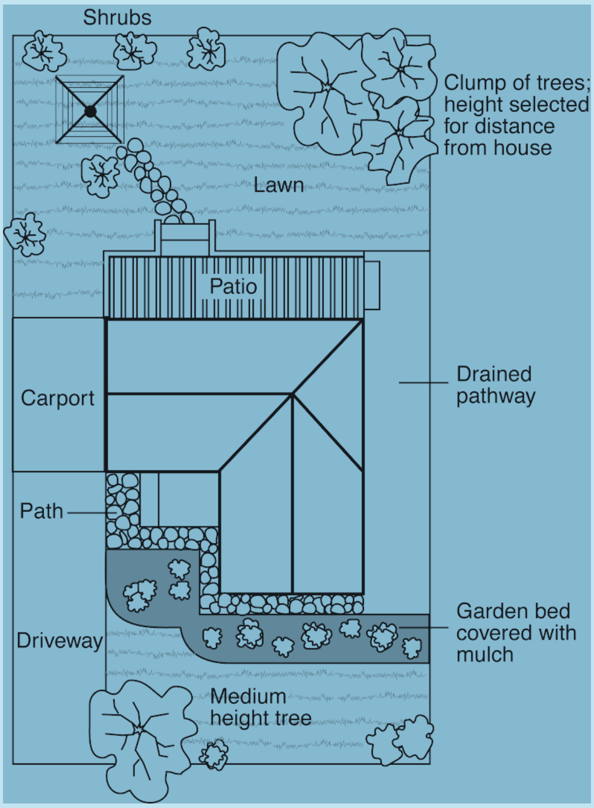
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

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

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

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

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au
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APPENDIX B

FOUNDATION PERFORMANCE AND MAINTENANCE

(Informative)

B1 GENERAL

The designs and design methods given in this Standard are based on the performance criteria of Clause 1.3. Importantly, significant damage may be avoided provided the foundation site conditions are properly maintained. This is expressed in Section 1 by the statement that the probability of failure for reasonable site conditions is low, but is higher if extreme conditions are encountered. It is neither practicable nor economical to design for the extreme conditions that could occur in the foundation if a site is not properly maintained. The expected standard of foundation maintenance is described in Paragraph B2.

Some minor cracking and movement will occur in a significant proportion of buildings, particularly those on reactive clays, and the various levels of damage are discussed in Paragraph B3.

The performance requirements of a concrete floor in respect to shrinkage cracking and moisture reaction with adhesives are discussed in Paragraph B4.

A more extensive discussion of the material in Paragraphs B2 to B4 is contained in the CSIRO pamphlet, Building Technology File 18, *Foundation maintenance and footing performance: A homeowner's guide*, and its recommendations should be followed.

B2 FOUNDATION MAINTENANCE

B2.1 Foundation soils

All soils are affected by water. Silts are weakened by water and some sands can settle if heavily watered, but most problems arise on clay foundations. Clays swell and shrink due to changes in moisture content and the potential amount of the movement is implied in the site classification in this Standard, which is designated as follows:

(a) A — stable (non-reactive).

(b) S — slightly reactive.

(c) M — moderately reactive.

(d) H1 and H2 — highly reactive.

(e) E — extremely reactive.

Sites classified Class A and Class S may be treated as non-reactive sites in accordance with Paragraph B2.2. Sites classified as Class M, Class H1, Class H2 and Class E should comply with the recommendations given in Paragraph B2.3.

B2.2 Class A and Class S sites

Sands, silts and clays should be protected from becoming extremely wet by adequate attention to site drainage and prompt repair of plumbing leaks.

B2.3 Classes M, H1, H2 and E sites

Sites classified as M, H1, H2, or E should be maintained at essentially stable moisture conditions and extremes of wetting and drying prevented. This will require attention to the following:

(a) *Drainage of the site* The site should be graded or drained so that water cannot pond against or near the building. The ground immediately adjacent to the building should be graded to a uniform fall of 50 mm minimum away from the building over the first metre. The subfloor space for buildings with suspended floors should be graded or drained to prevent ponding where this may affect the performance of the footing system.

The site drainage recommendations should be maintained for the economic life of the building.

(b) *Limitations on gardens* The development of the gardens should not interfere with the drainage requirements or the subfloor ventilation and weephole drainage systems. Garden beds adjacent to the building should be avoided. Care should be taken to avoid overwatering of gardens close to the building footings.

(c) *Restrictions on trees and shrubs* Planting of trees should be avoided near the foundation of a building or neighbouring building on reactive sites as they can cause damage due to drying of the clay at substantial distances. To reduce, but not eliminate, the possibility of damage, tree planting should be restricted to a distance from the house as follows:

  (i) 1½ × mature height for Class E sites.

  (ii) 1 × mature height for Class H1 and Class H2 sites.

  (iii) ¾ × mature height for Class M sites.

Where rows or groups of trees are involved, the distance from the building should be increased. Removal of trees from the site can also cause similar problems.

Alternatively, the footing system may be designed for the effect of trees, for example as given in Appendix H.

(d) *Repair of leaks* Leaks in plumbing, including stormwater and sewerage drainage, should be repaired promptly.

The level to which these measures are implemented depends on the reactivity of the site. The measures apply mainly to masonry buildings and masonry veneer buildings. For frame buildings clad with timber or sheeting, lesser precautions may be appropriate.

B3 PERFORMANCE OF WALLS

It is acknowledged that minor foundation movements occur on nearly all sites and that it is impracticable to design a footing system that will protect the building from movement under all circumstances. The expected performance of footing systems designed in accordance with the Standard is defined in terms of the damage classifications in Table C1, Appendix C.

Crack width is used as the major criterion for damage assessment, although tilting and twisting distortions can also influence the assessment. Local deviations of slope of walls exceeding 1:150 are undesirable. The assessment of damage may also be affected by where it occurs and the function of the building, although these effects are not likely to be significant in conventional buildings. In the classification of damage, account should also be taken of the history of cracking. For most situations Category 0 or 1 should be the limit; however, under adverse conditions, Category 2 should be expected although such damage should be rare. Significant damage is defined as Category 3 or worse.

For Category 1 or 2 damage, remedial action should consist of stabilizing the moisture conditions of the clay and paying attention to repairing or disguising the visual damage. This should be regarded as part of the normal maintenance of buildings on reactive clays.

Even significant masonry cracking with crack widths over 5 mm often has no influence on the function of the wall and only presents an aesthetic problem. Generally, the remedial action for such damage should start with an investigation to establish the cause of the damage. In many cases the treatment should consist of stabilizing moisture conditions by physical barriers or paths, or replenishing moisture in dry foundations. This may be followed by repair of the masonry and, wherever possible, added articulation should be included while repairs are being effected. Structural repairs to the footing system, such as deep underpinning, should only be considered as the last resort.

Underpinning should generally be avoided where the problem is related to reactive clays, although it is recognized there may be occasional situations where underpinning or other structural augmentation work is appropriate. None of this structural augmentation work should be undertaken without proper engineering appraisal.

In some cases, walls may be designed to span sagging footings and cantilever beyond hogging footings. In such cases, satisfactory performance will involve the wall remaining free of cracks and articulation joint movements, and remaining within the limits for the particular jointing system.

B4 PERFORMANCE OF CONCRETE FLOORS

Shrinkage cracking can be expected in concrete floors. Concrete floors can also be damaged by shrinkage or swelling of reactive clays or settlement of fill. The categories of movement causing the damage are given in Table C2, Appendix C. In the classification, account should be taken of whether the damage is stable or likely to increase, and an allowance should be made for any deviations in level which resulted from, or occurred during, construction.

The time of attachment of floor coverings and the selection of the adhesive for them should take into account the moisture in the concrete floor and its possible effect on adhesion. Concrete floors can take a considerable time to dry (three to nine months).

Floor coverings and their adhesives can be damaged by moisture in the concrete and by the shrinkage that occurs as the concrete dries. The time of fixing of floor coverings and the selection of the adhesive should take these factors into account.

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Appendix D

Approximate borehole locations

BHM Geotechnical

Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 –AA
Approved:	MB			
Date:	08/08/2023		Drawing No:	**CHP 2293 –AA plan 1**
Scale:	NTS			

North: Gosford Hospital

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 -AA
	Approved:	MB			
	Date:	8/08/2023		Drawing No:	**CHP 2293-AA plan 2**
	Scale:	NTS			

East: Gosford Railway corridor

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 -AA
	Approved:	MB			
	Date:	8/08/2023		Drawing No:	**CHP 2293-AA plan 3**
	Scale:	NTS			

South: Residential

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 -AA
	Approved:	MB			
	Date:	8/08/2023		Drawing No:	**CHP 2293-AA plan 4**
	Scale:	NTS			

West: Residential

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 -AA
	Approved:	MB			
	Date:	8/08/2023		Drawing No:	**CHP 2293-AA plan 5**
	Scale:	NTS			

BH01 rock core

7.7 m – 20 m

BHM Geotechnical	Drawn:	DZ	**Residential Development** **60 & 62-64 Showground Rd,** **Gosford NSW**	Job No:	CHP 2293 –AA
	Approved:	MB			
	Date:	08/08/2023		Drawing No:	**CHP 2293 –AA plan 6**
	Scale:	NTS			

BH02 rock core

9.1 m – 19.8 m

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 –AA
	Approved:	MB			
	Date:	08/08/2023		Drawing No:	**CHP 2293 –AA plan 7**
	Scale:	NTS			

BH03 rock core

4 m – 20 m

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 –AA
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	Date:	08/08/2023		Drawing No:	**CHP 2293 –AA plan 8**
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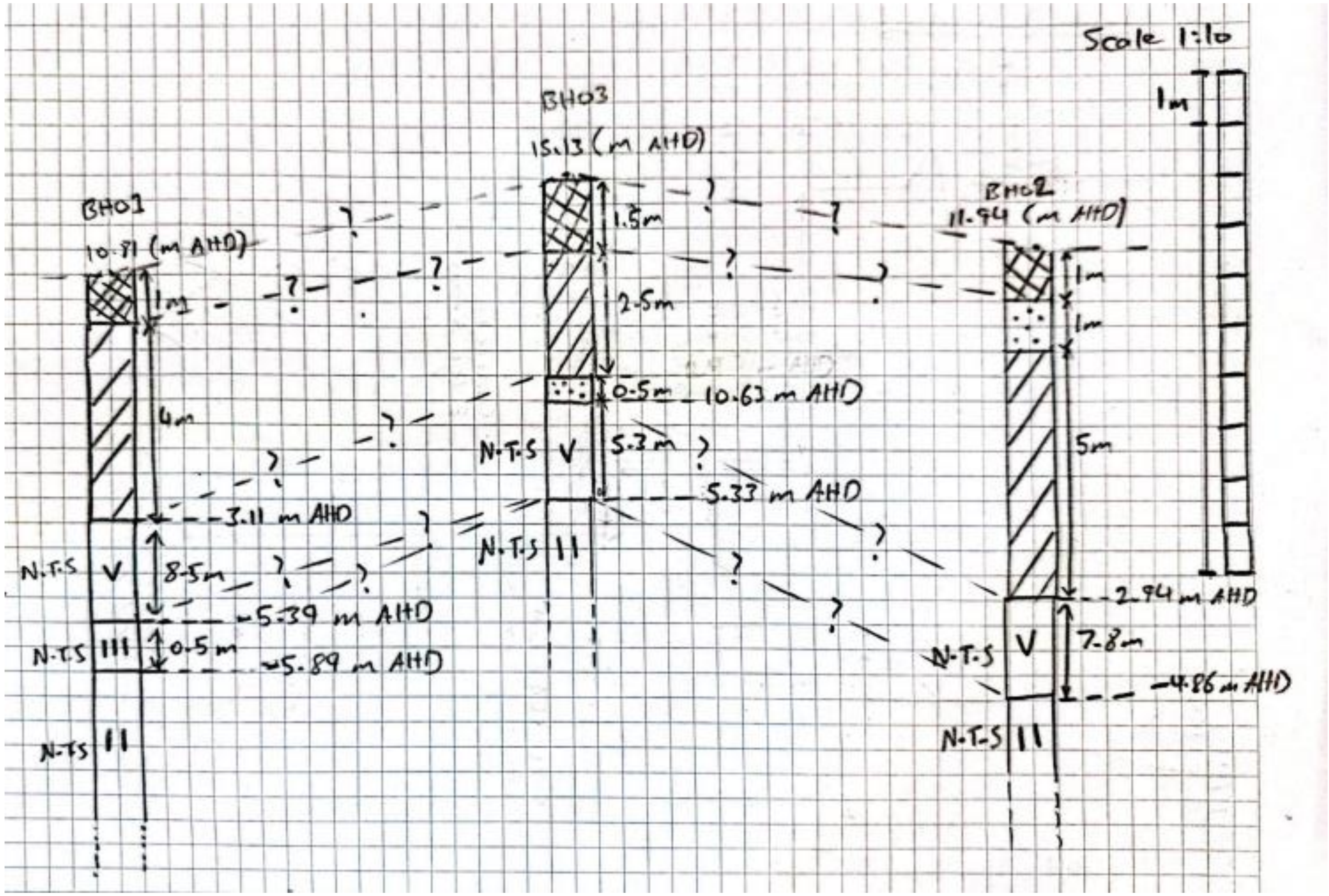

Cross section sketch

BHM Geotechnical	Drawn:	DZ	**Residential Development 60 & 62-64 Showground Rd, Gosford NSW**	Job No:	CHP 2293 –AA
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	Date:	08/08/2023			
	Scale:	NTS			

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Appendix E

Integrated Medical Office Building
Showground Rd, Gosford

Development Numbers

Street Address:	60, 62 and 64 Showground Road, Gosford
Property Description:	Lot 1-4 on SP 20095 and Lots 1-6 on SP 20058
Site Area:	2437sqm
Proposal Description:	Mixed use development consisting of an integrated health hub facility and basement car parking. Consisting of retail and medical land uses such as GP clinic, potential pharmacy, radiology, pathology as well as a cafe on the ground level; with 4 levels of medical suites above.

Carparking Numbers

Ground
2 Motorcycle Bays
20 Bike Parks

Basement 1
44 Car Spaces
4 Accessible Car Spaces
9 Motorcycle Bays
2 Van Space
38 Bike Parks

Basement 2
70 Car Spaces

Basement 3
42 Car Spaces

Total Carparking Numbers
156 Car Spaces
4 Accessible Car Spaces
11 Motorcycle Bays
2 Van Space
58 Bike Parks

Drawing List

Drawing No.	Drawing Name
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00.02	GFA Calculations
01.01	Site Plan
01.02	Existing Survey
01.03	Demolition Plan
01.04	Excavation Plan
03.02	Floor Plan - Basement 3
03.03	Floor Plan - Basement 2
03.04	Floor Plan - Basement 1
03.05	Floor Plan - Ground Floor
03.06	Floor Plan - First Floor
03.07	Floor Plan - Second Floor
03.08	Floor Plan - Third Floor
03.09	Floor Plan - Fourth Floor
04.01	Roof Plan
09.01	Elevations - North
09.02	Elevations - East
09.03	Elevations - South
09.04	Elevations - West
10.01	Section A
10.02	Section B
10.03	Section C
22.01	North-Eastern Perspective
22.02	Showground Rd Perspective
22.03	South-Eastern Perspective
22.04	Showground Road Context

Image to be replaced

Brisbane
1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116
Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

tvsarchitects.com.au
info@tvsarchitects.com.au

PROJECT
Gosford Health Hub
PROJECT ADDRESS
60-64 Showground Road, Gosford
DRAWING TITLE
Cover Sheet

Drawing No.	Revision
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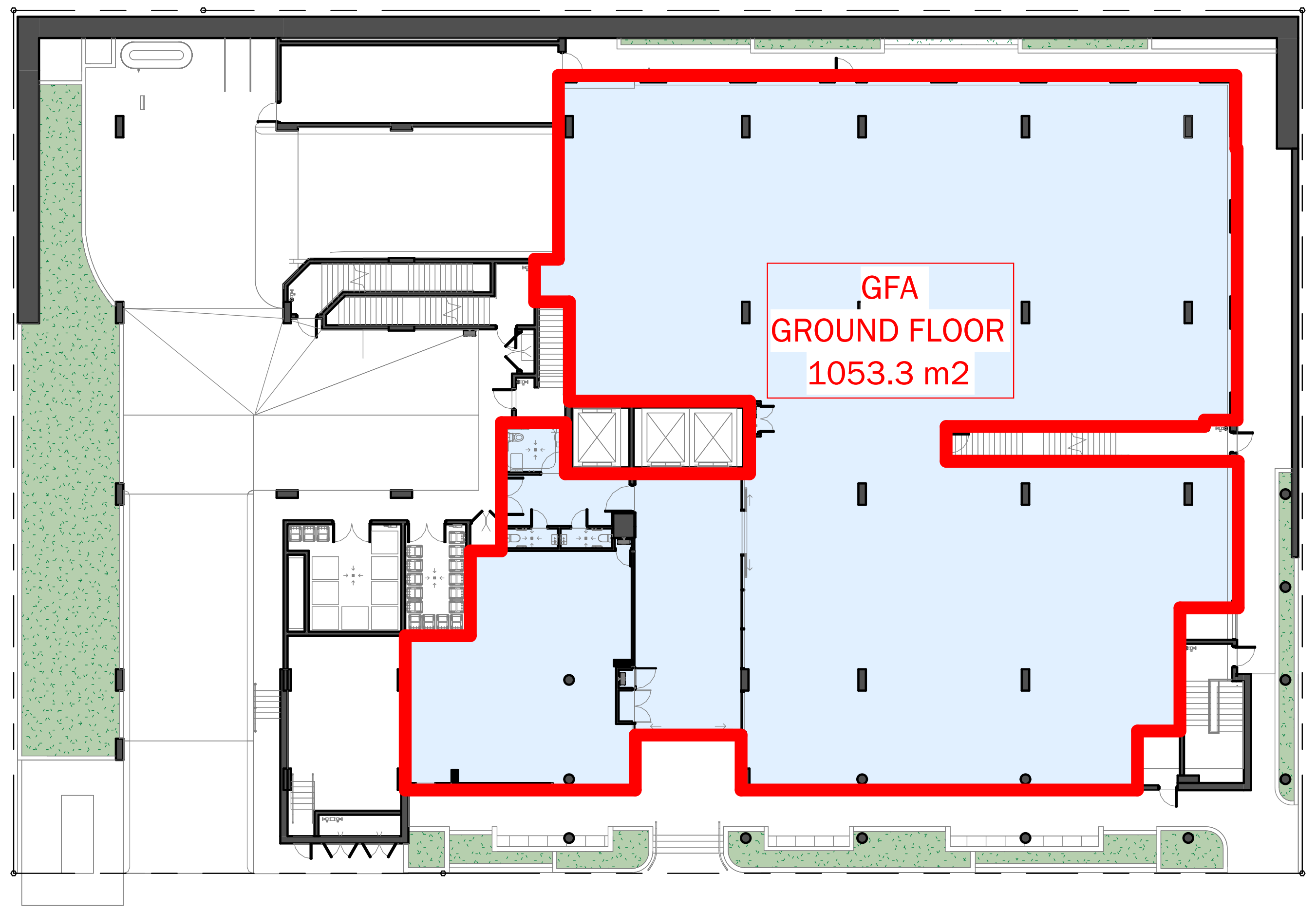

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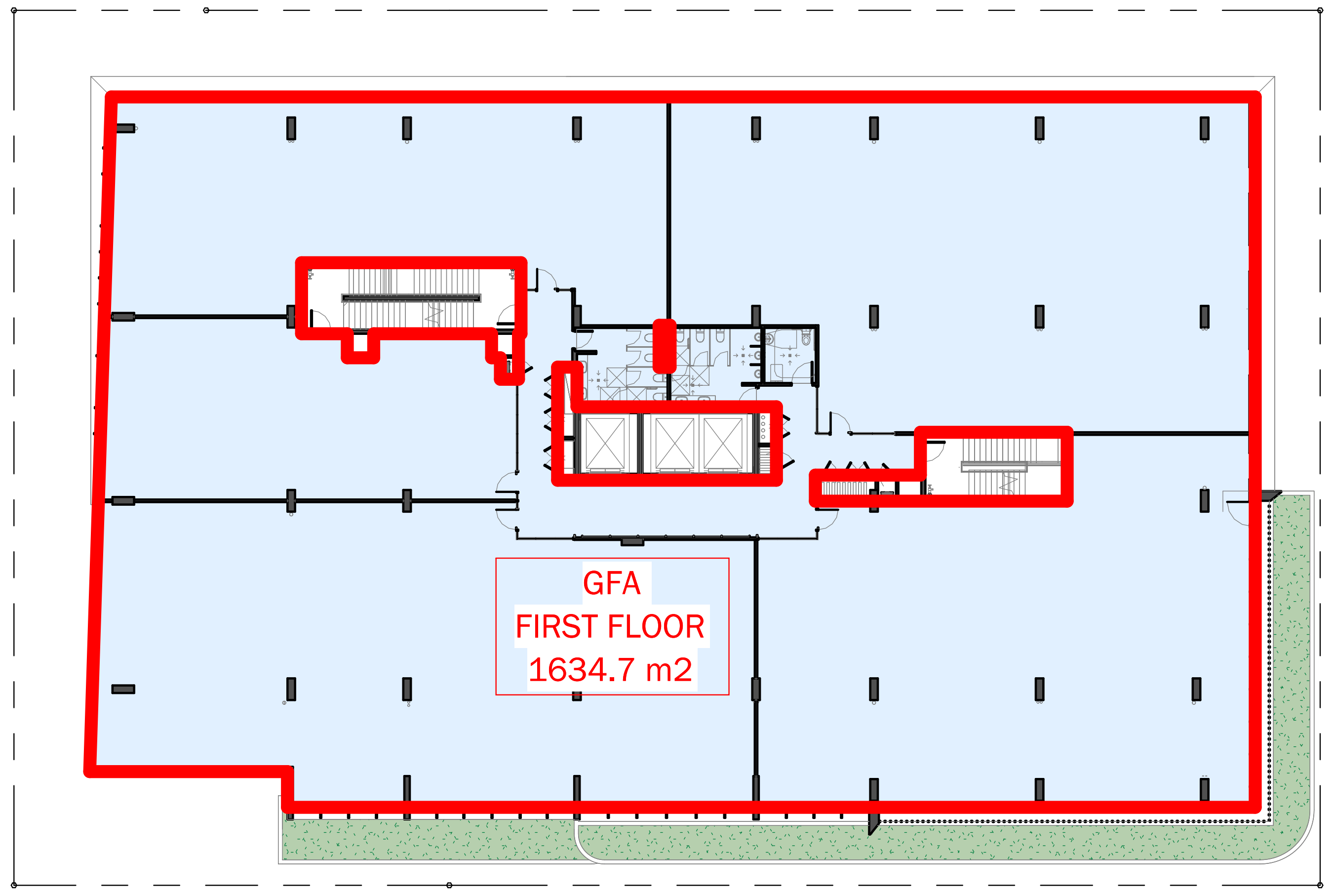

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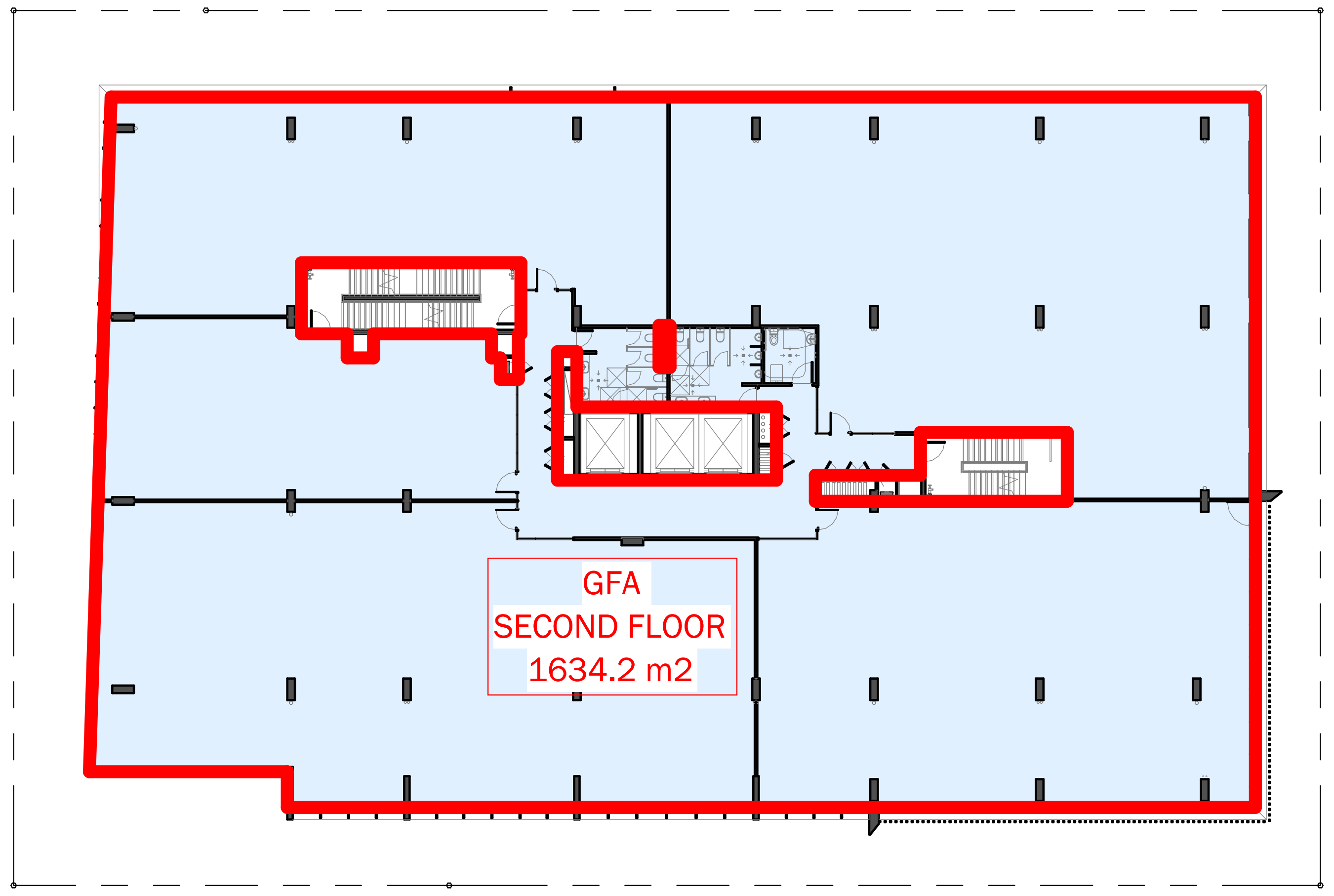

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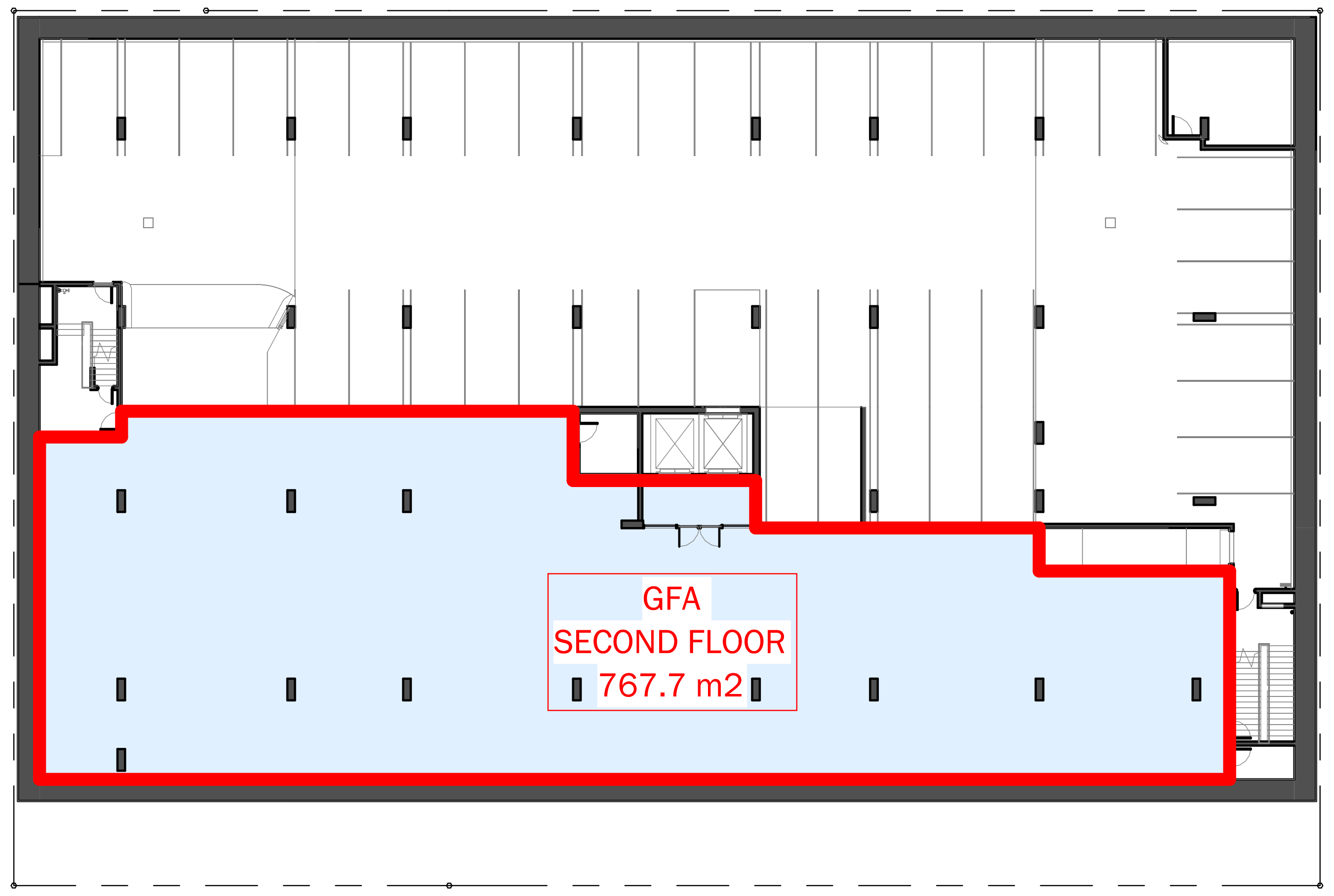

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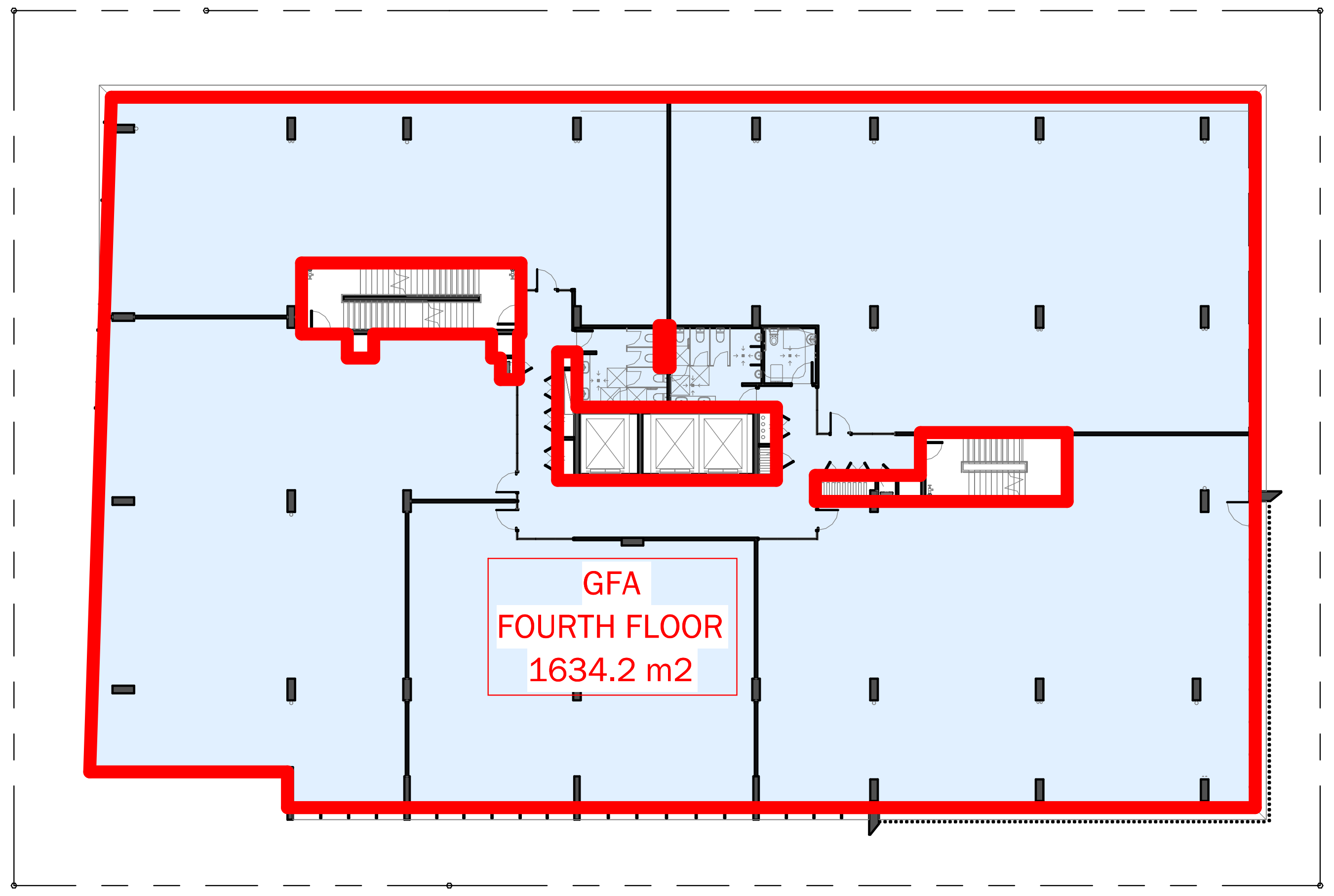

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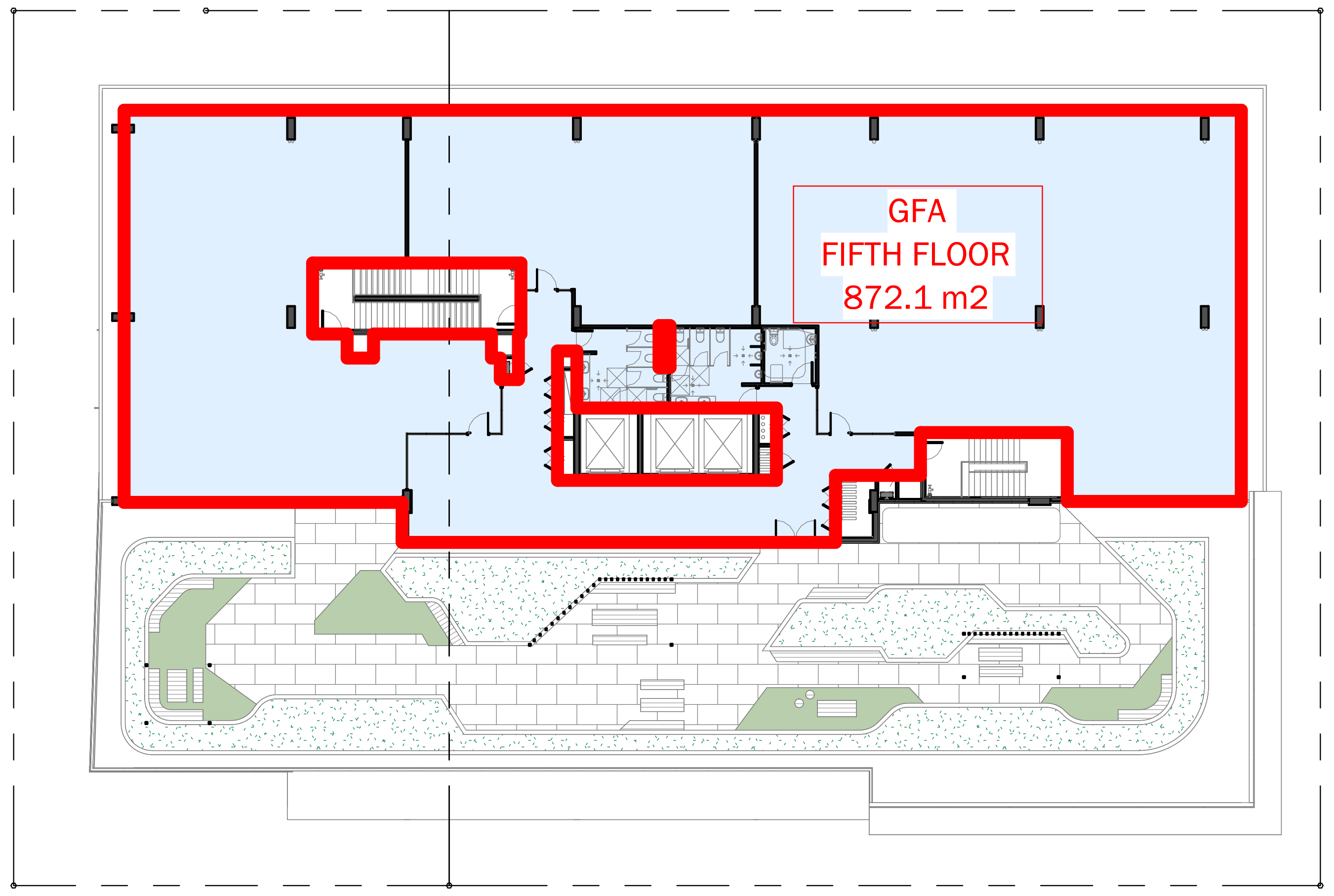

6 | Scale @ A1 | **GFA - Fourth Floor**
09.01 | 1 : 300

GFA Calculations

Definition for GFA taken from NSW State Environmental Planning Policy (Schedule 10 Dictionary for Chapter 5)

Storey	GFA	NLA
Basement 3	767.7	751.66
Ground Floor	1053.3	926.57
First Floor	1634.7	1462.53
Second Floor	1634.2	1462.58
Third Floor	1634.2	1463.17
Forth Floor	872.1	690.06
TOTAL	7596.2m2	6756.57m2

TVS

Brisbane
1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

tvsarchitects.com.au
info@tvsarchitects.com.au

PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
GFA Calculations

N

0 5 10 25
Scale (m) 1 : 250 @A1
Scale (m) 1 : 500 @A3

Drawing No.	Revision
6245.DA.00.02	F

TVS

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1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
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PROJECT
Gosford Health Hub

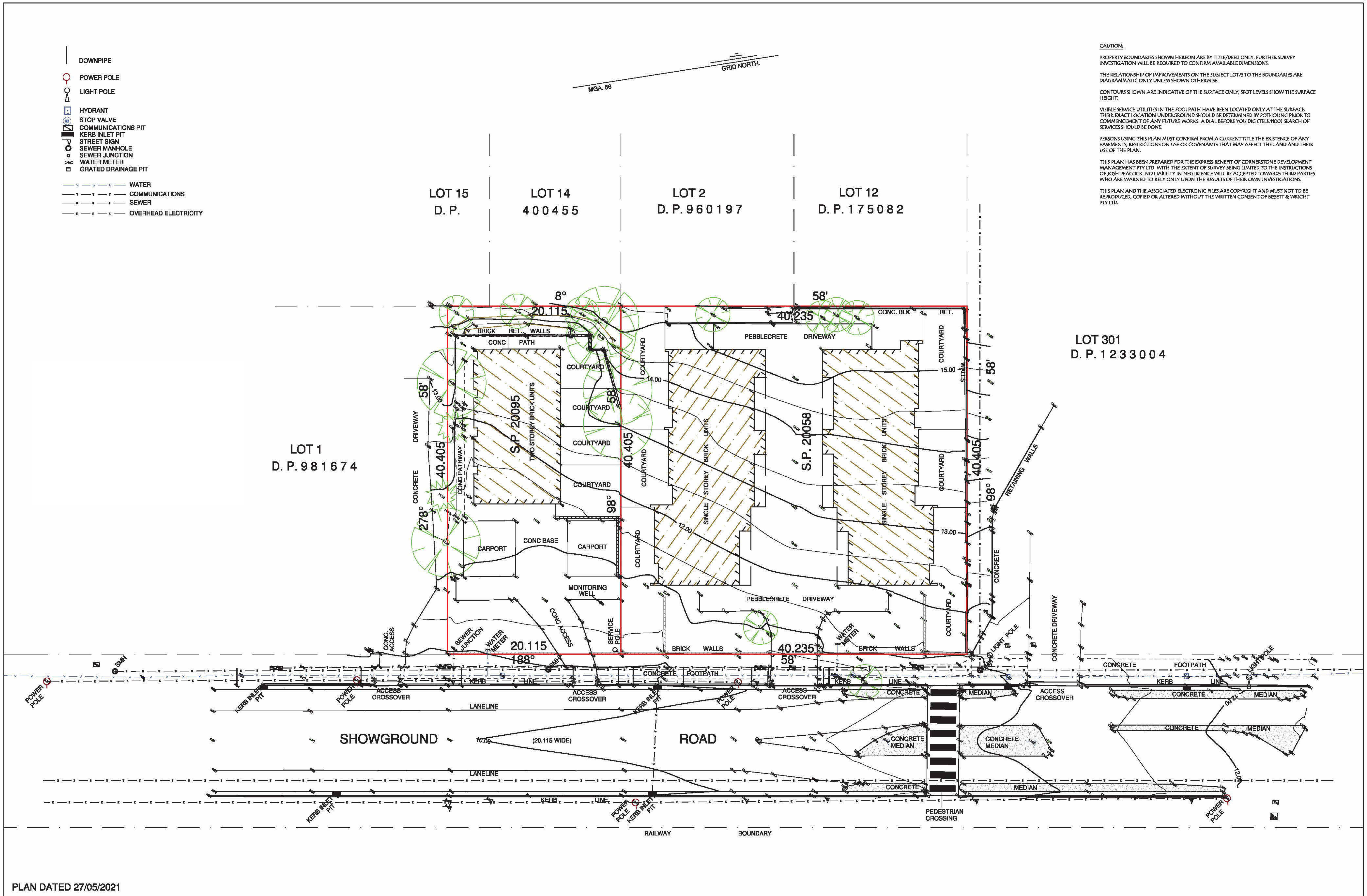
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Site Plan

N

Drawing No.	Revision
6245.DA.01.01	H

1/05/2024 9:39:00 AM



CAUTION:

PROPERTY BOUNDARIES SHOWN HEREON ARE BY TITLE/DEED ONLY. FURTHER SURVEY INVESTIGATION WILL BE REQUIRED TO CONFIRM AVAILABLE DIMENSIONS.

THE RELATIONSHIP OF IMPROVEMENTS ON THE SUBJECT LOT/S TO THE BOUNDARIES ARE DIAGRAMMATIC ONLY UNLESS SHOWN OTHERWISE.

CONTOURS SHOWN ARE INDICATIVE OF THE SURFACE ONLY, SPOT LEVELS SHOW THE SURFACE HEIGHT.

VISIBLE SERVICE UTILITIES IN THE FOOTPATH HAVE BEEN LOCATED ONLY AT THE SURFACE. THEIR EXACT LOCATION UNDERGROUND SHOULD BE DETERMINED BY POTHOLING PRIOR TO COMMENCEMENT OF ANY FUTURE WORKS. A DIAL BEFORE YOU DIG (TELE.1100) SEARCH OF SERVICES SHOULD BE DONE.

PERSONS USING THIS PLAN MUST CONFIRM FROM A CURRENT TITLE THE EXISTENCE OF ANY EASEMENTS, RESTRICTIONS ON USE OR COVENANTS THAT MAY AFFECT THE LAND AND THEIR USE OF THE PLAN.

THIS PLAN HAS BEEN PREPARED FOR THE EXPRESS BENEFIT OF CORNERSTONE DEVELOPMENT MANAGEMENT PTY LTD WITH THE EXTENT OF SURVEY BEING LIMITED TO THE INSTRUCTIONS OF JOSH PEACOCK. NO LIABILITY IN NEGLIGENCE WILL BE ACCEPTED TOWARDS THIRD PARTIES WHO ARE WARNED TO RELY ONLY UPON THE RESULTS OF THEIR OWN INVESTIGATIONS.

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PLAN DATED 27/05/2021

ORIGIN OF LEVELS:- PM 19236 RL = 14.712 AHD

DIAL BEFORE YOU DIG
www.1100.com.au

PROPERTY DETAILS
LOT/D.P: - SP 20058 & SP 20095
STREET:- SHOWGROUND ROAD
SUBURB:- GOSFORD

AMENDMENTS	BY	DATE

DATUM: A.H.D

CAD DATABASE FILE
FILE REFERENCE :- 15346
COMPUTER FILE:- 15346DET
DRAWING FILE:- 15346DET.DWG

BISSETT & WRIGHT
PTY LIMITED. ACN 001 312 812
CONSULTANTS IN LAND
SURVEYING, ENGINEERING AND PLANNING.
SUITE 3
71a VICTORIA STREET
EAST GOSFORD NSW 2250
PHONE : 02 43 243799
FAX : 02 43 247941
EMAIL: bwsurvey@optusnet.com.au

SCALE :- 1:1000 @ A1
GRID :- MGA
CONTOUR INTERVAL : 0.5m
DATE OF SURVEY :- 19/05/2021

SURFACE DETAIL PLAN

CLIENT:- CORNERSTONE DEVELOPMENT MANAGEMENT PTY LTD
PLAN No:- 1 DATE:- 27/05/2021
SHEET 1 OF 1 SHEETS.

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1/9 Edmondstone St, South Brisbane Q 4101
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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Existing Survey

N

Drawing No.	Revision
6245.DA.01.02	H

Removal of existing vegetation along Western boundary

Demolition of existing single storey brick units

Removal of existing vegetation along Western boundary

Demolition of existing concrete retaining wall along Western boundary. Retaining wall to be reconstructed

Removal of concrete pathway along Southern boundary

Removal of existing vegetation

Demolition of existing two storey brick units

Demolition of all existing courtyards

Demolition of existing carports

Existing driveway and crossover to be removed. Reinstate existing kerb and footpath

Sewer junction & water meter to be relocated as per proposed design

Demolition of existing concrete retaining wall along Northern boundary. Retaining wall to be reconstructed

Demolition of existing single storey brick units

Demolition of all existing courtyards

Existing driveway and crossover to be removed. Reinstate existing kerb and footpath

Demolition of all existing courtyards

Demolition of neighbouring retaining wall the increase the connection (to neighbouring site) and amenity

Demolition of brick walls along Showground Road

Service pole to be relocated as per proposed design

Removal of existing vegetation

Existing water meter to be relocated as per proposed design

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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

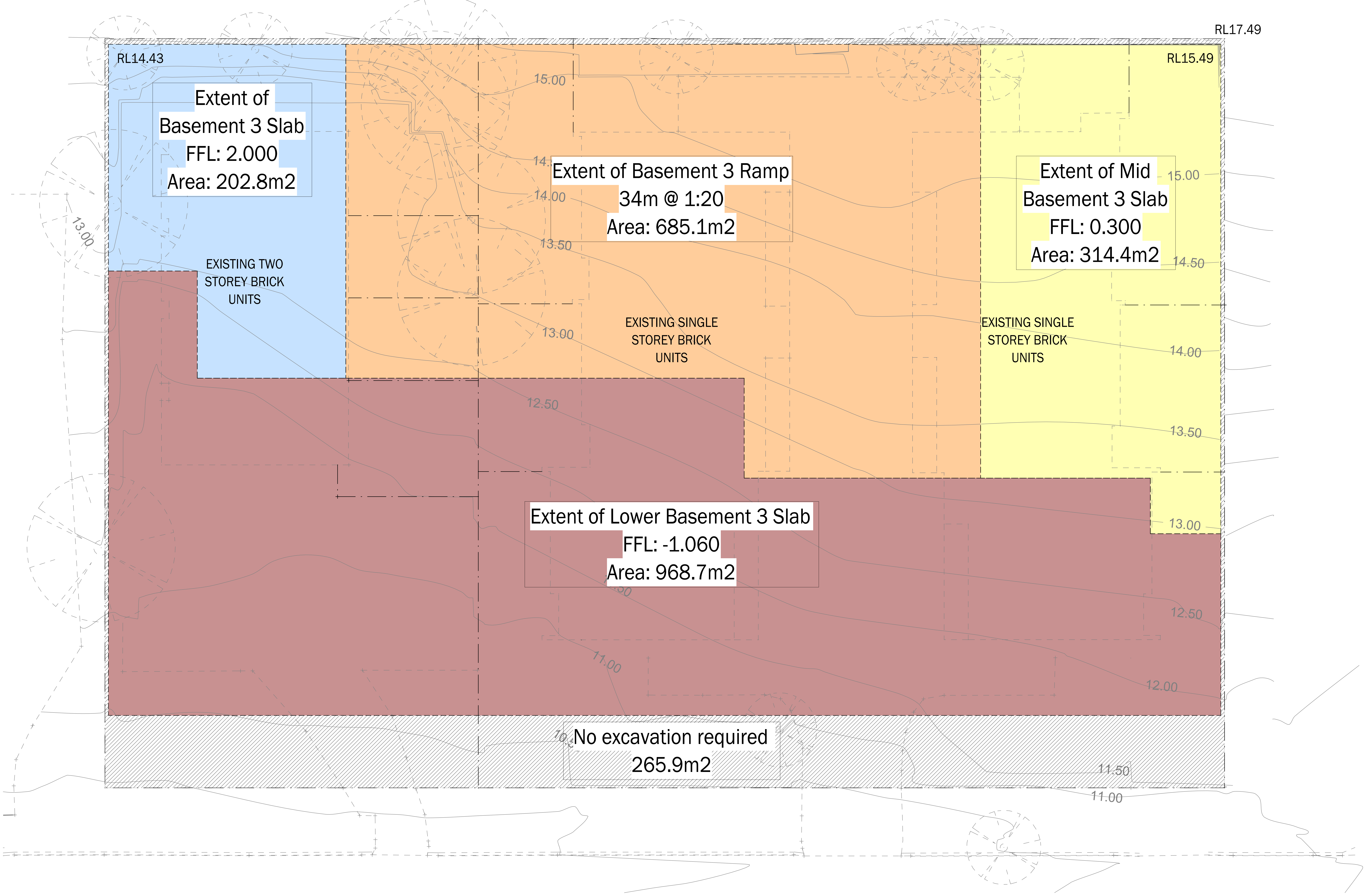
DRAWING TITLE
Demolition Plan

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.01.03	E

1/05/2024 9:39:01 AM



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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Excavation Plan

N

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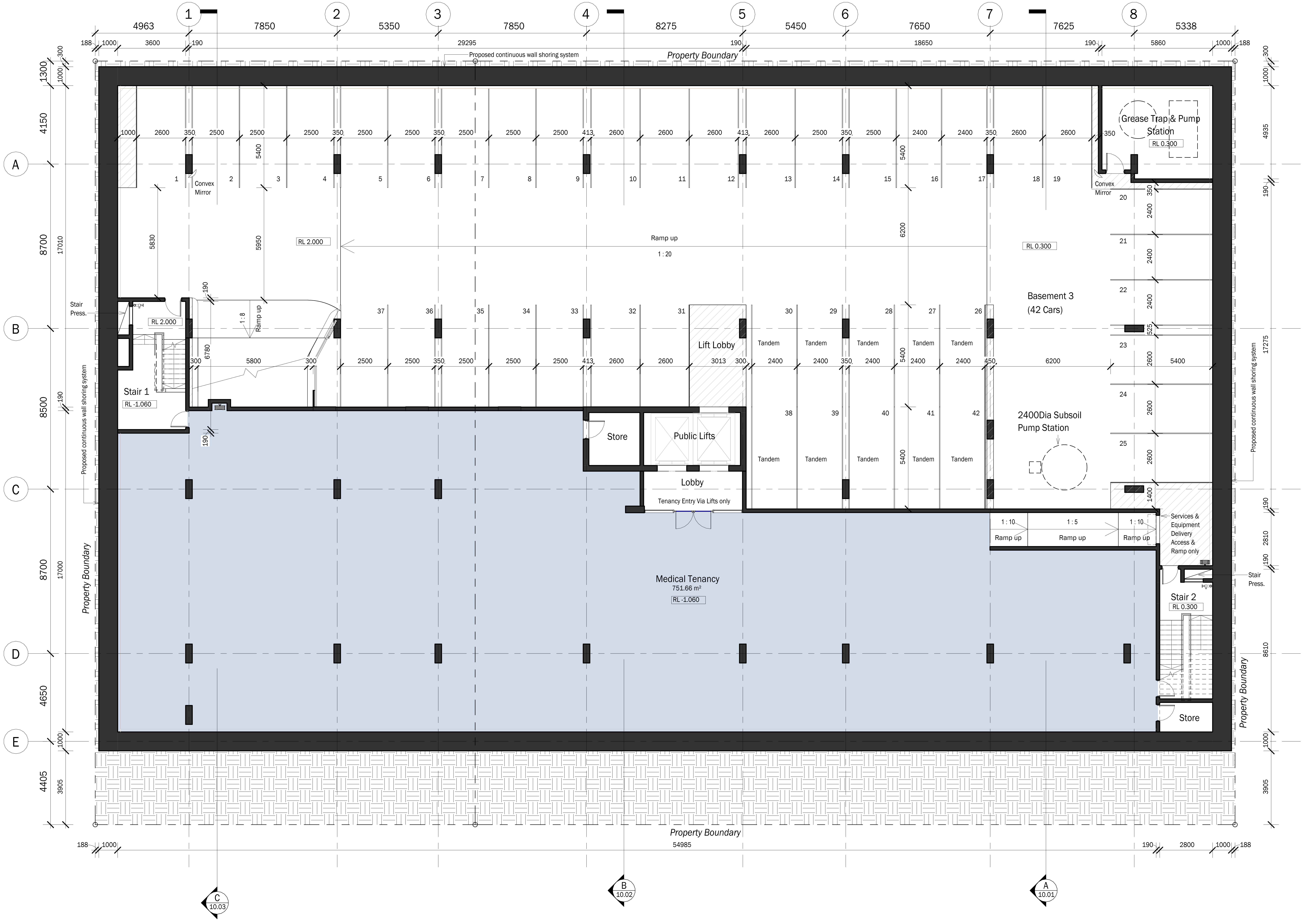
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.01.04	E

1/05/2024 9:39:02 AM



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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Floor Plan - Basement 3

N

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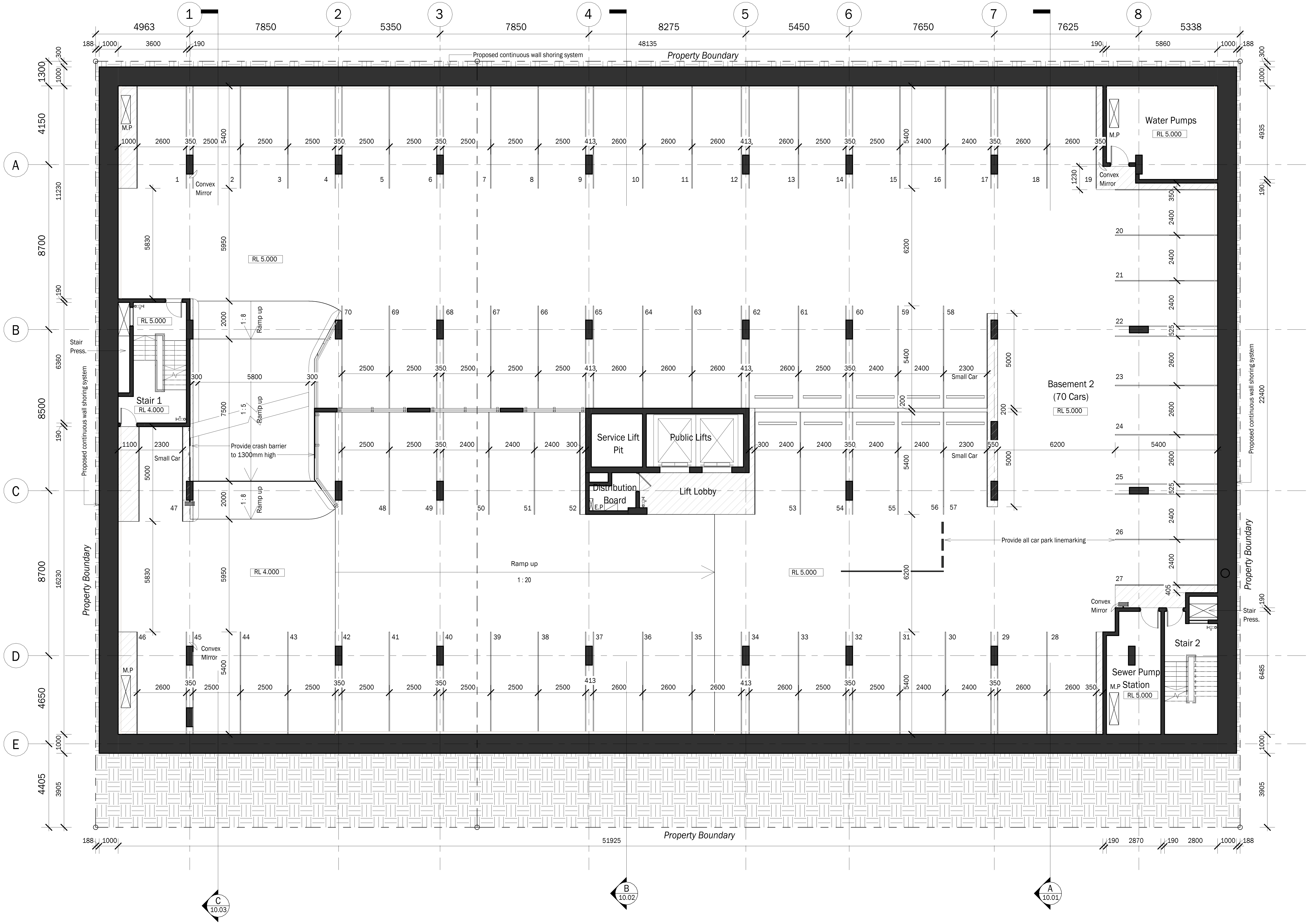
Scale (m) 1 : 100 @A1 Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.02	K



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+61 07 5574 2266
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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

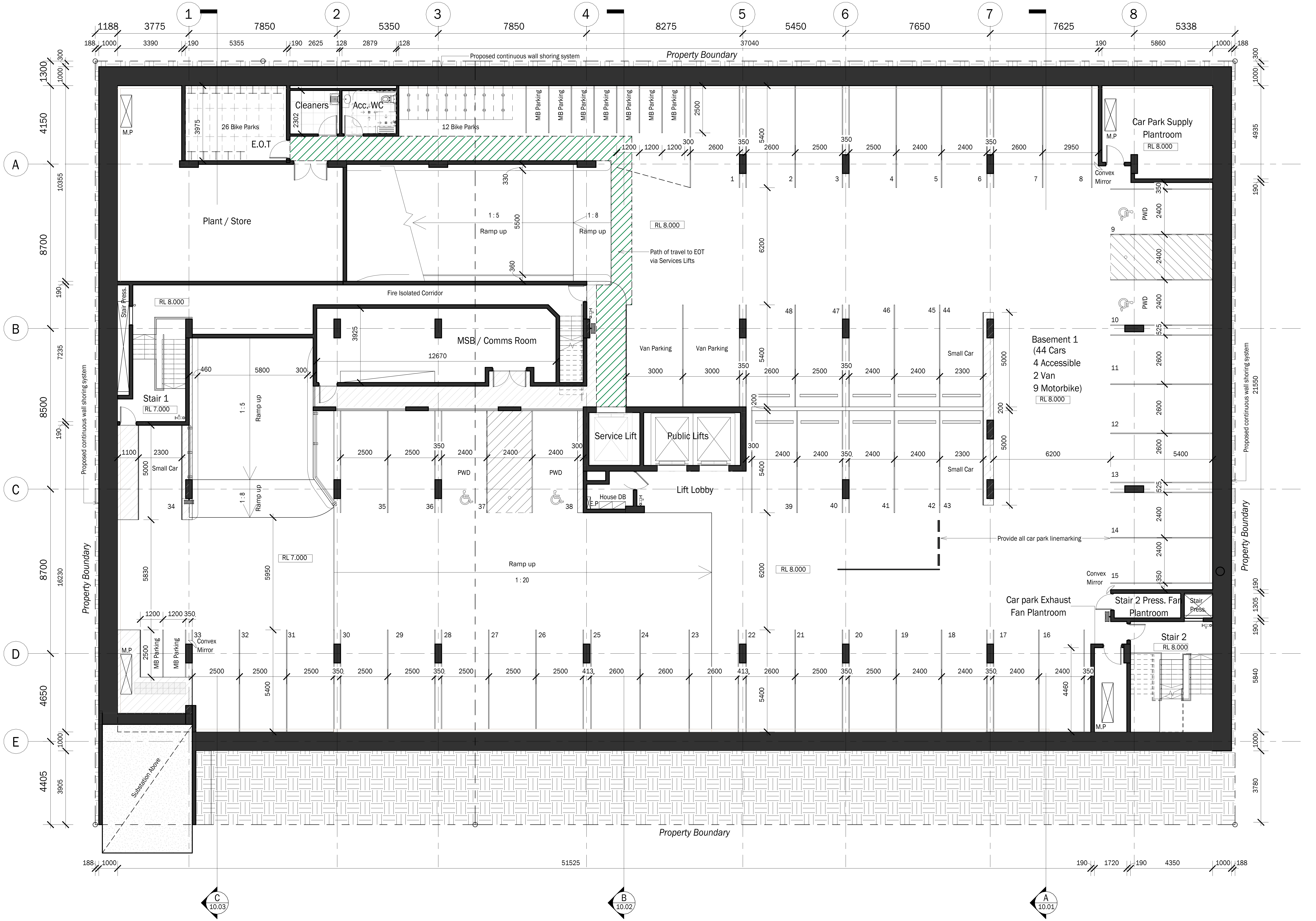
DRAWING TITLE
Floor Plan - Basement 2

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.03	K

1/05/2024 11:01:46 AM



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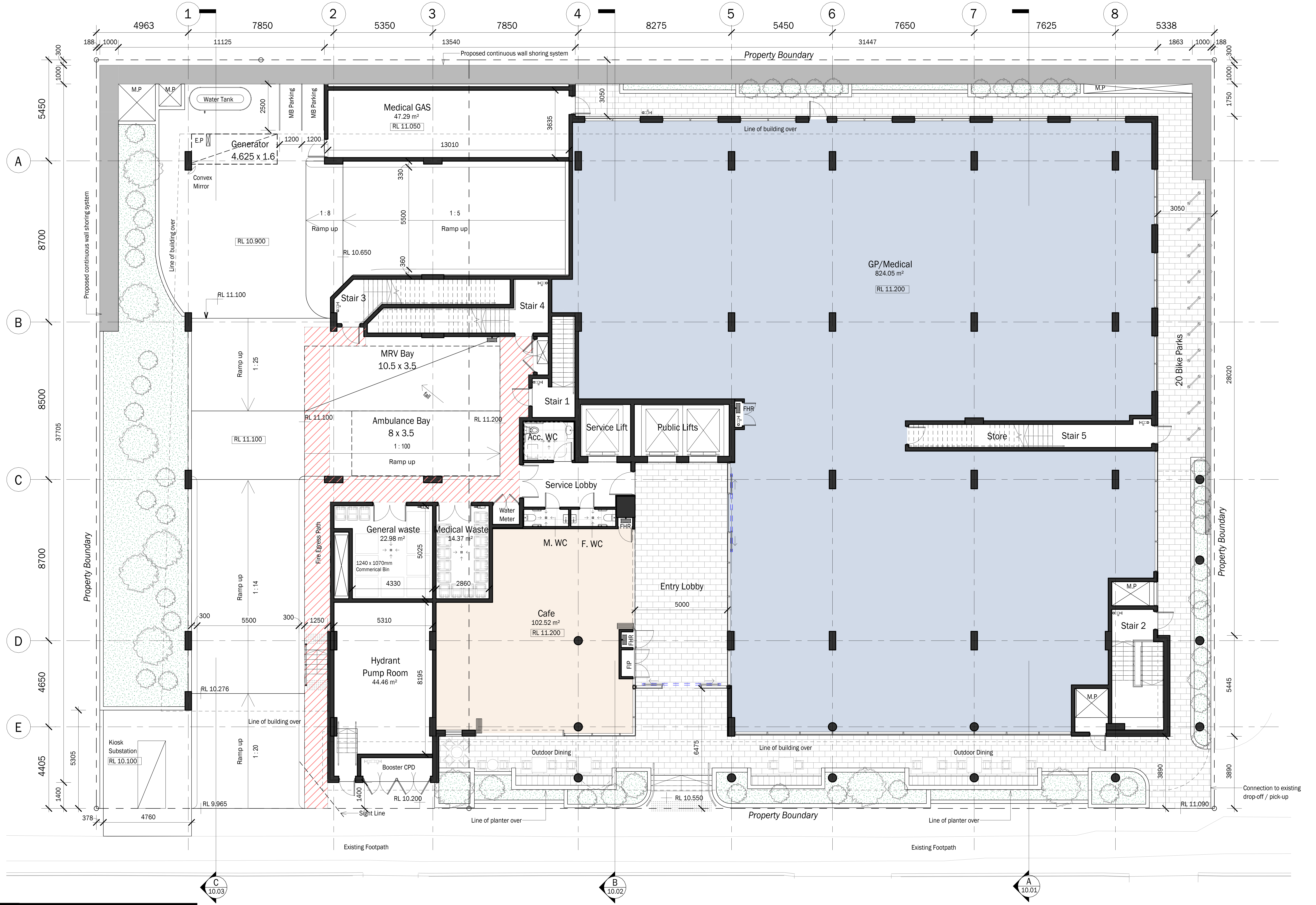
PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Floor Plan - Basement 1

Drawing No.	Revision
6245.DA.03.04	L



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1/9 Edmondstone St, South Brisbane Q 4101
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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

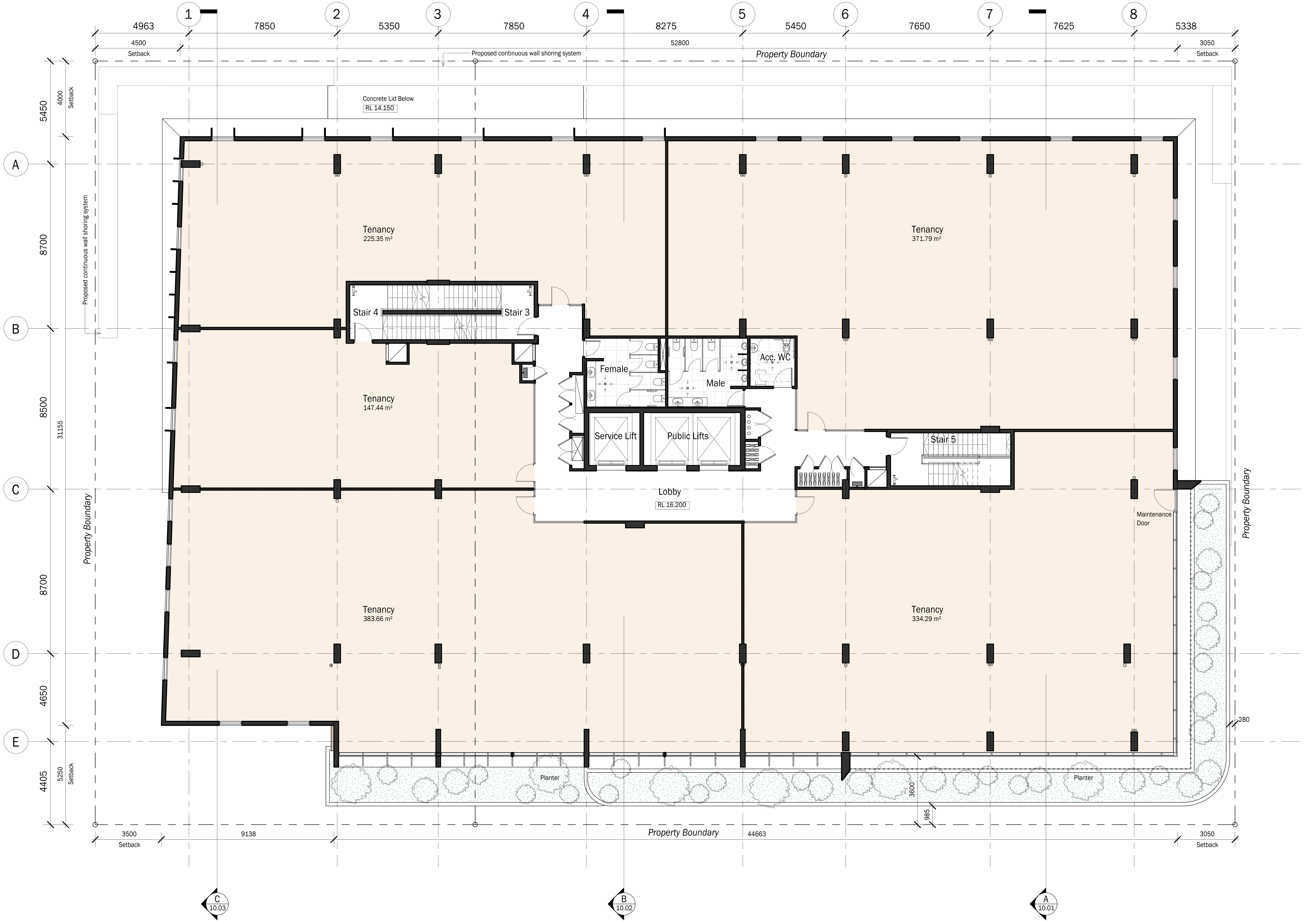
DRAWING TITLE
Floor Plan - Ground Floor

N

0 2 4 10
Scale (m) 1 : 100 @A1 Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.05	M

1/05/2024 4:19:44 PM



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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

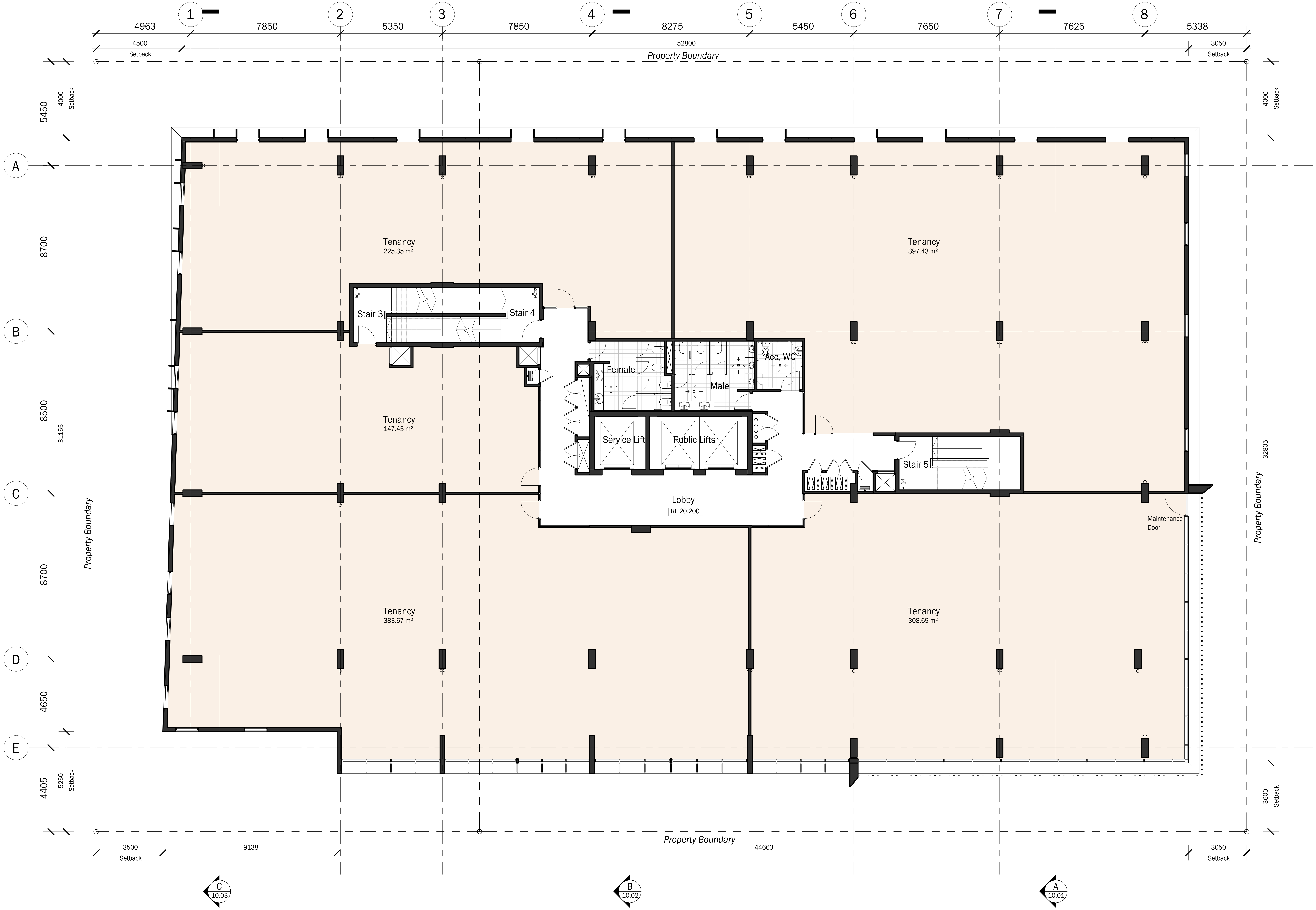
DRAWING TITLE
Floor Plan - First Floor

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.06	K

1/05/2024 11:15:04 AM



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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

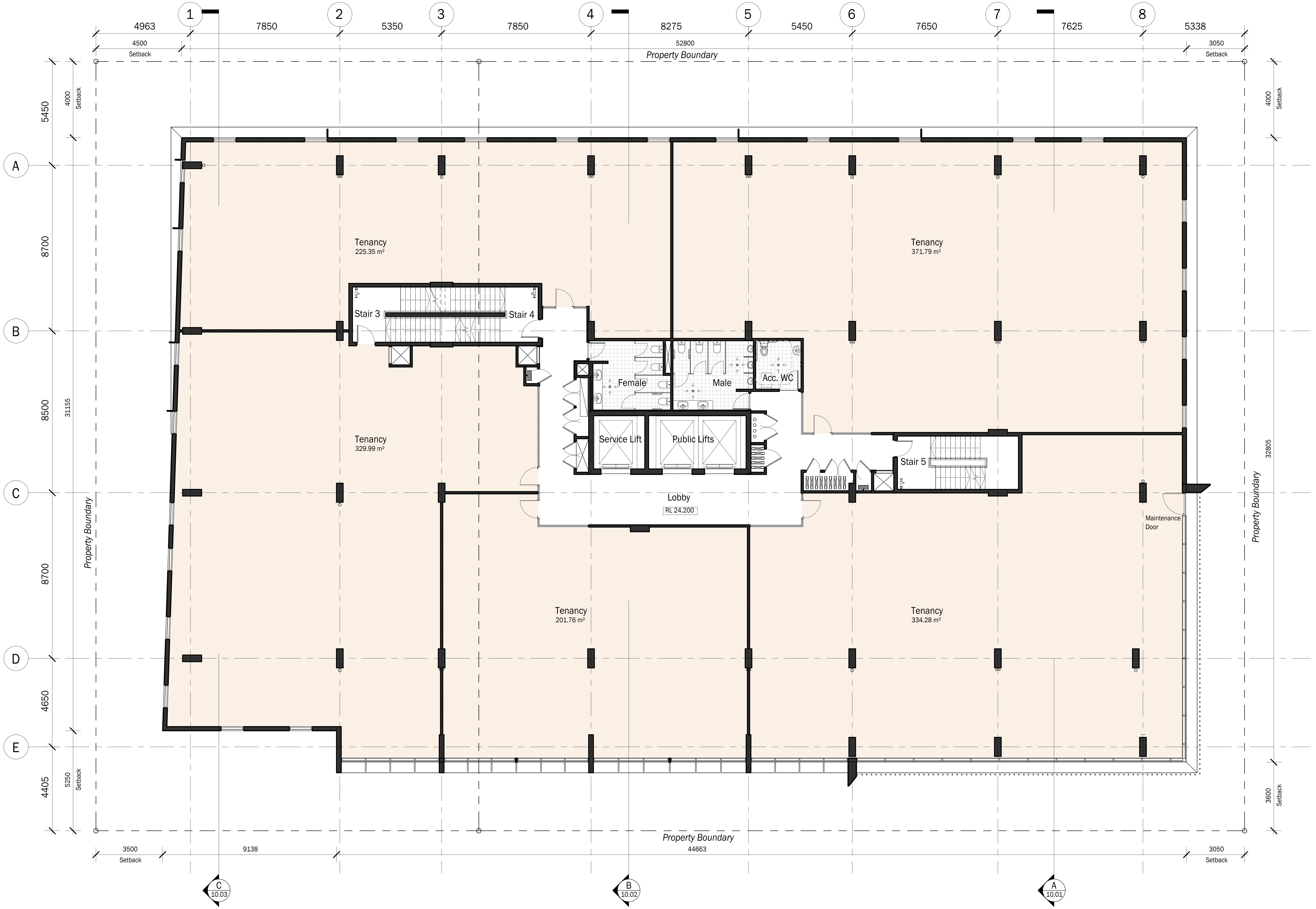
DRAWING TITLE
Floor Plan - Second Floor

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.07	J

1/05/2024 11:01:53 AM



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1/9 Edmondstone St, South Brisbane Q 4101
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Gold Coast
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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

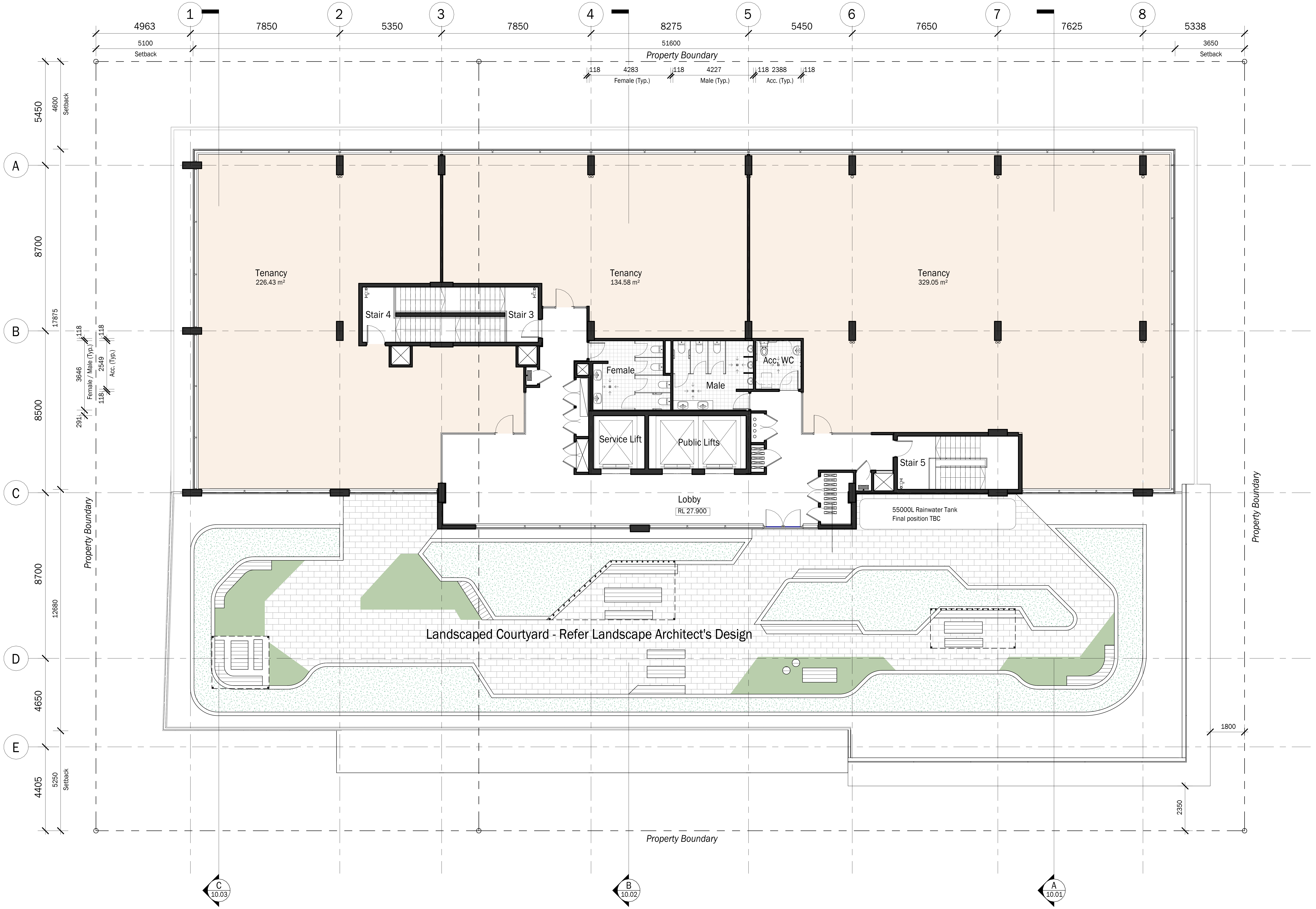
DRAWING TITLE
Floor Plan - Third Floor

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.08	J

1/05/2024 11:01:55 AM



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1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
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PROJECT
Gosford Health Hub

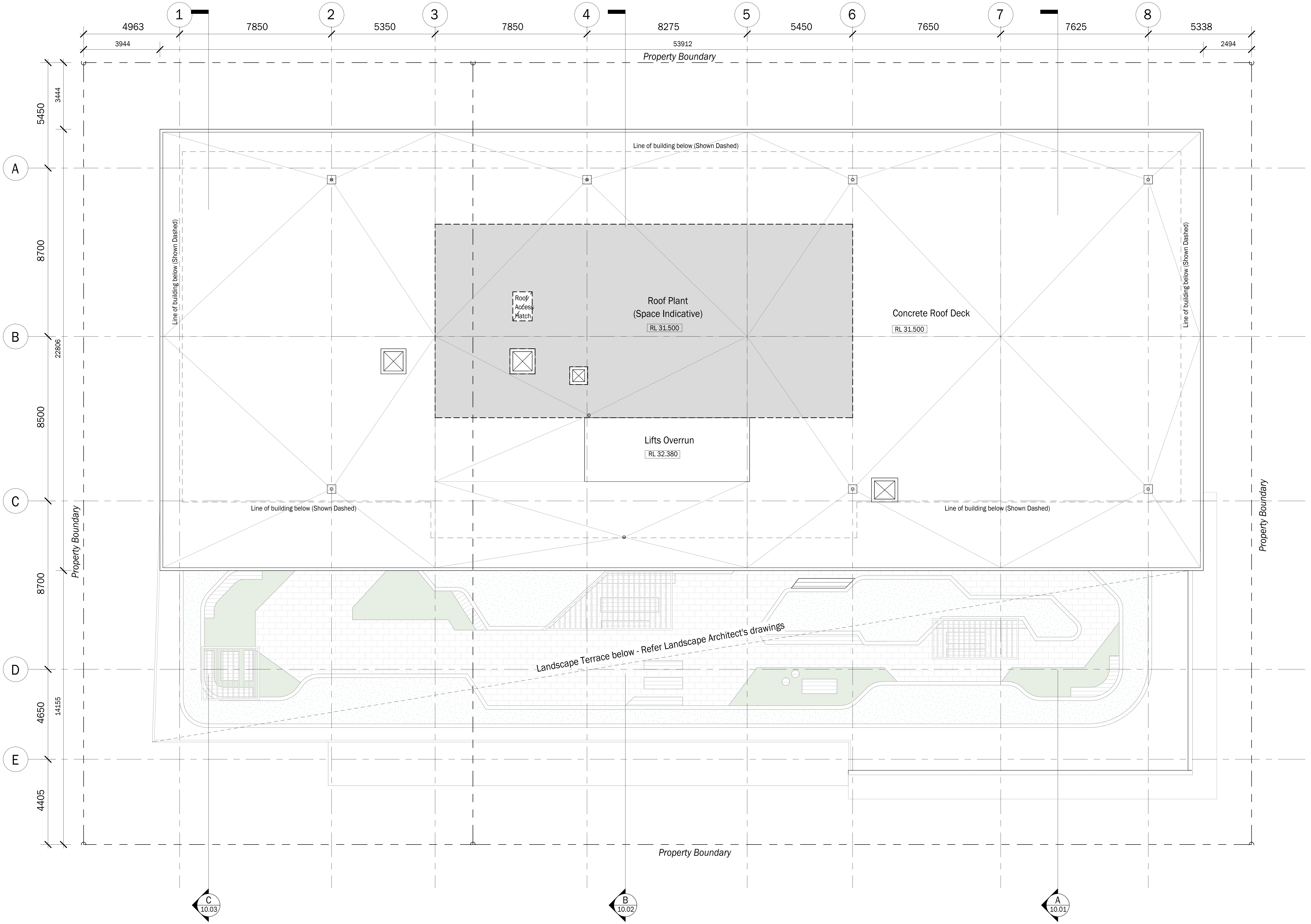
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Floor Plan - Fourth Floor

N

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.03.09	J



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1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

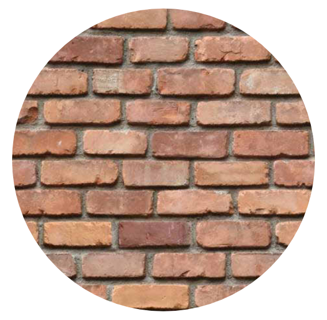
DRAWING TITLE
Roof Plan

N

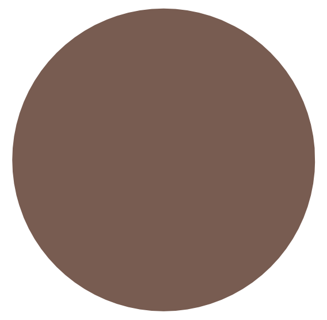
0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.04.01	J

1/05/2024 11:01:58 AM

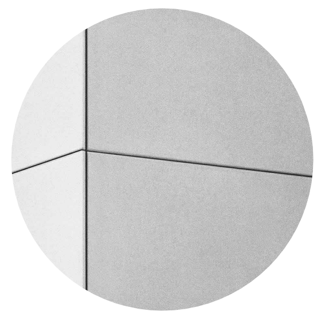

BRK-01
Austral Bricks
Nubrik Pressed Brick Range Spencer Tan

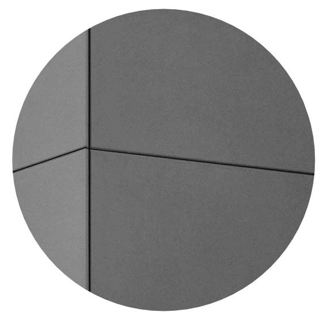

REN-01
Blockwork
Rendered Paint Finish - White


REN-02
Blockwork or Concrete
Rendered Paint Finish - Brown / Bronze


SCR-01
50 x 50 Aluminium Battens
@ 250 Centres
Powdercoated Finish - White


FC-01
FC Cladding
Painted Finish - White


ETC-01
Exo-Tec Cladding
Painted Finish - Light Grey


ETC-02
Exo-Tec Cladding
Painted Finish - Medium Grey


ETC-03
Exo-Tec Cladding
Painted Finish - Dark Grey

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Brisbane
1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

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info@tvsarchitects.com.au

PROJECT
Gosford Health Hub

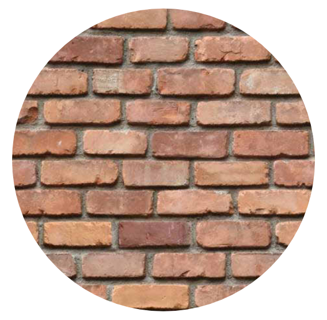
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Elevations - North

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

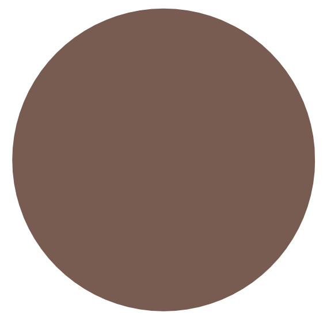
Drawing No.	Revision
6245.DA.09.01	I

1/05/2024 11:02:02 AM



BRK-01
Austral Bricks
Nubrik Pressed Brick Range Spencer Tan

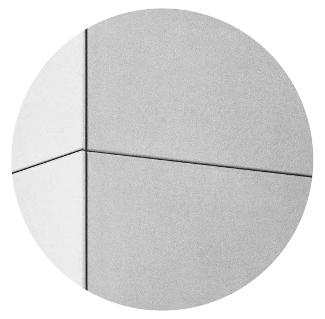
REN-01
Blockwork
Rendered Paint Finish - White



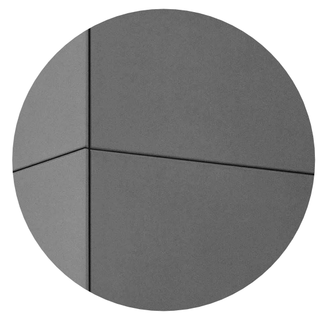
REN-02
Blockwork or Concrete
Rendered Paint Finish - Brown / Bronze

SCR-01
50 x 50 Aluminium Battens
@ 250 Centres
Powdercoated Finish - White

FC-01
FC Cladding
Painted Finish - White



ETC-01
Exo-Tec Cladding
Painted Finish - Light Grey



ETC-02
Exo-Tec Cladding
Painted Finish - Medium Grey

ETC-03
Exo-Tec Cladding
Painted Finish - Dark Grey

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+61 07 3831 2116

Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

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PROJECT
Gosford Health Hub

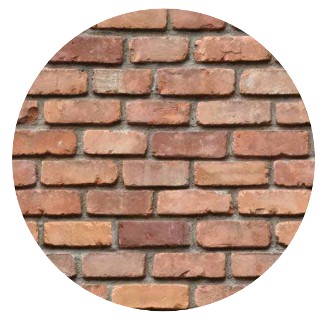
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Elevations - East

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.09.02	J

1/05/2024 4:19:48 PM

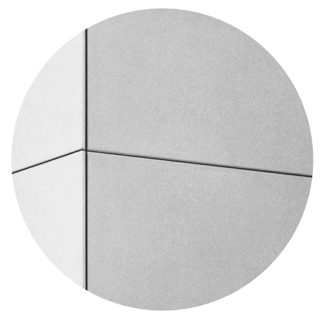

BRK-01
Austral Bricks
Nubrik Pressed Brick Range Spencer Tan

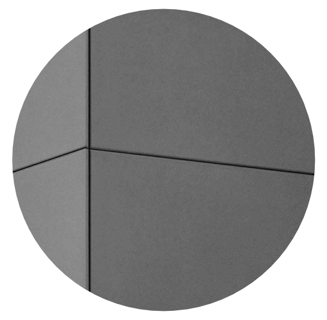

REN-01
Blockwork
Rendered Paint Finish - White

🟫
REN-02
Blockwork or Concrete
Rendered Paint Finish - Brown / Bronze


SCR-01
50 x 50 Aluminium Battens
@ 250 Centres
Powdercoated Finish - White


FC-01
FC Cladding
Painted Finish - White


ETC-01
Exo-Tec Cladding
Painted Finish - Light Grey


ETC-02
Exo-Tec Cladding
Painted Finish - Medium Grey


ETC-03
Exo-Tec Cladding
Painted Finish - Dark Grey

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+61 07 5574 2266

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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Elevations - South

0 2 4 10
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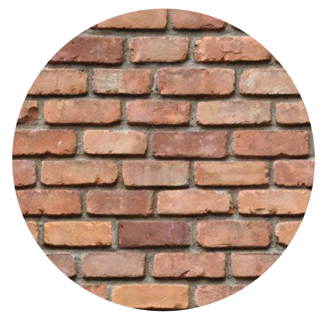
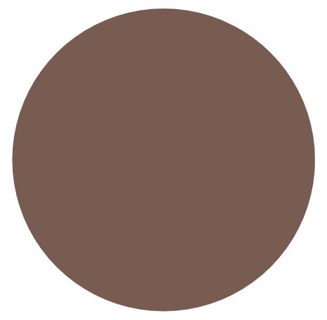
Drawing No.	Revision
6245.DA.09.03	I

1/05/2024 11:02:09 AM



BRK-01
Austral Bricks
Nubrik Pressed Brick Range Spencer Tan

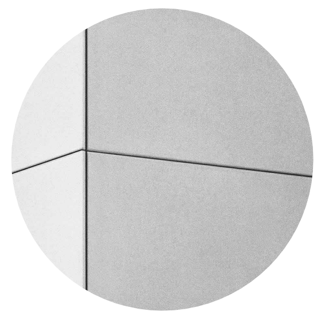
REN-01
Blockwork
Rendered Paint Finish - White



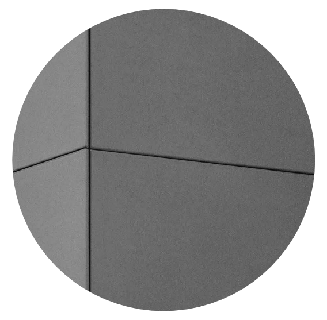
REN-02
Blockwork or Concrete
Rendered Paint Finish - Brown / Bronze

SCR-01
50 x 50 Aluminium Battens
@ 250 Centres
Powdercoated Finish - White

FC-01
FC Cladding
Painted Finish - White



ETC-01
Exo-Tec Cladding
Painted Finish - Light Grey



ETC-02
Exo-Tec Cladding
Painted Finish - Medium Grey

ETC-03
Exo-Tec Cladding
Painted Finish - Dark Grey

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PROJECT
Gosford Health Hub

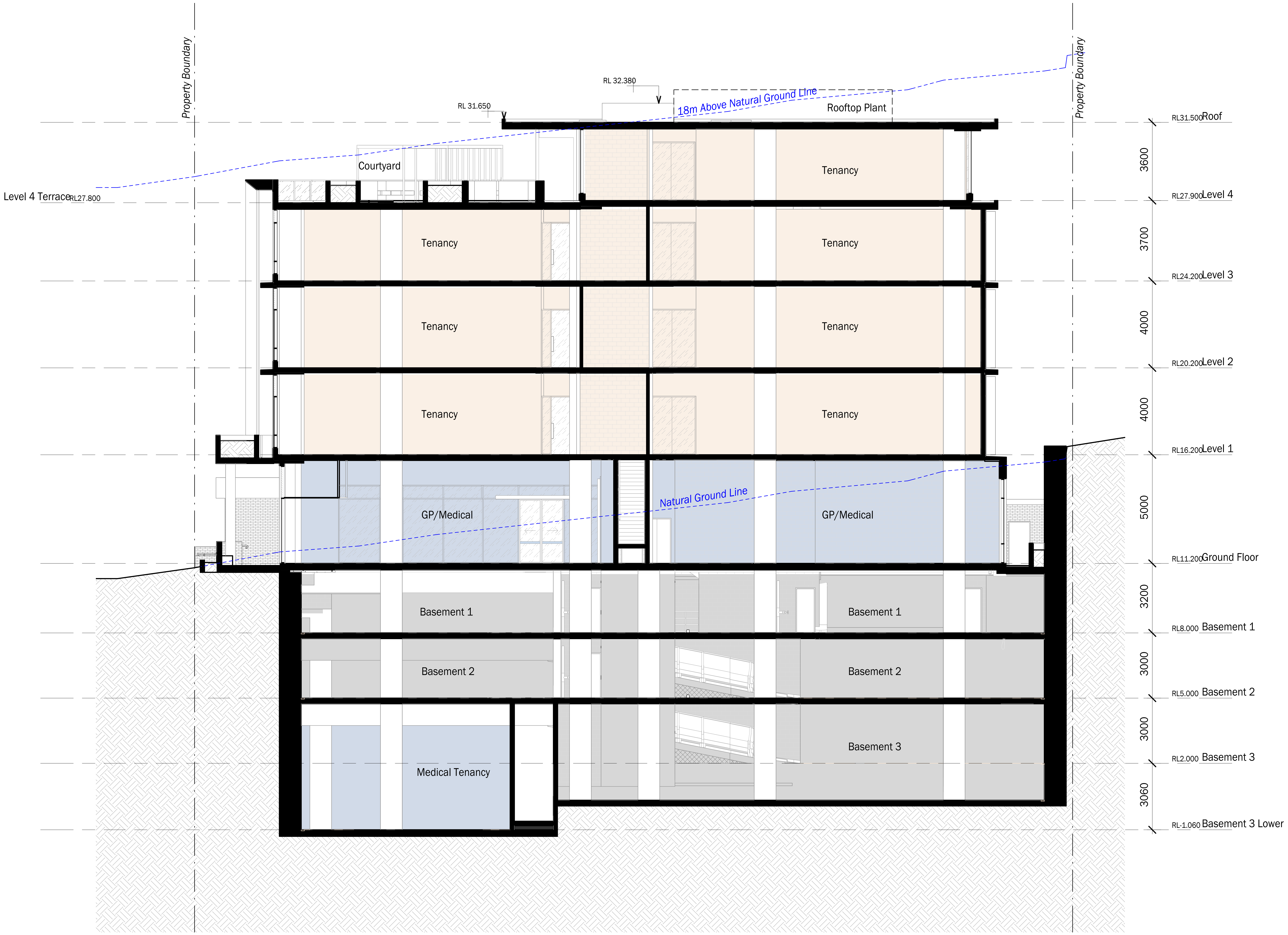
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Elevations - West

0 4 8 20
Scale (m) 1 : 200 @A1 Scale (m) 1 : 400 @A3

Drawing No.	Revision
6245.DA.09.04	I

1/05/2024 11:02:13 AM



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PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Section A

Drawing No.	Revision
6245.DA.10.01	H

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PROJECT
Gosford Health Hub

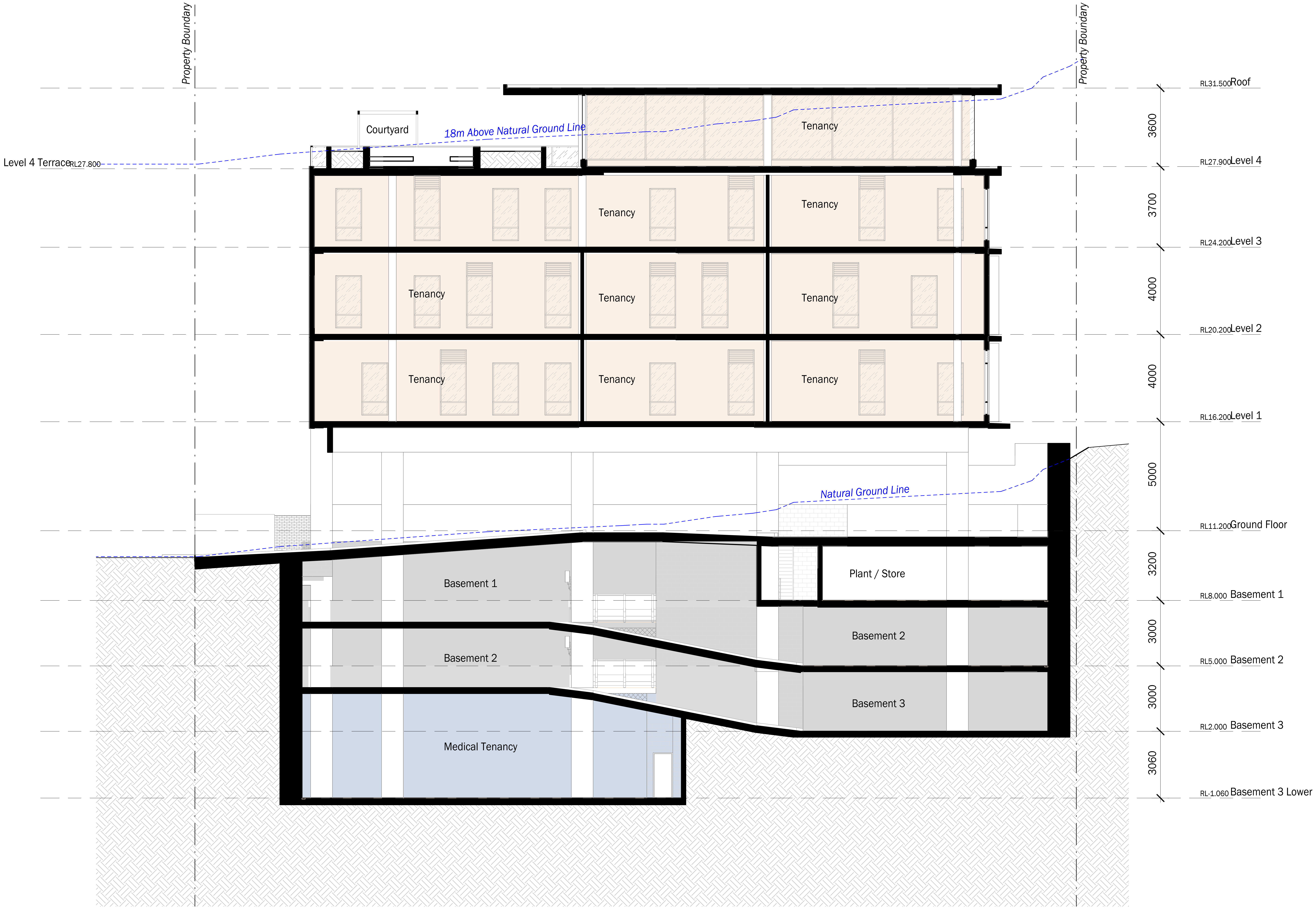
PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Section B

0 2 4 10
Scale (m) 1 : 100 @A1 Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.10.02	H

1/05/2024 11:02:18 AM



Brisbane
1/9 Edmondstone St, South Brisbane Q 4101
+61 07 3831 2116

Gold Coast
Level 9, 1 Corporate Crt, Bundall Q 4220
+61 07 5574 2266

tvsarchitects.com.au
info@tvsarchitects.com.au

PROJECT
Gosford Health Hub

PROJECT ADDRESS
60-64 Showground Road, Gosford

DRAWING TITLE
Section C

0 2 4 10
Scale (m) 1 : 100 @A1
Scale (m) 1 : 200 @A3

Drawing No.	Revision
6245.DA.10.03	H

1/05/2024 11:02:19 AM

This the document described as

Appendix F

Sydney Laboratory
Unit 5 / 43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax: (02) 9462 4710

Report No: SYD2301756
Issue No: 1

Point Load Strength Index - Report

Client: BHM Geotechnical
Project: Material Evaluation
Location: Not supplied
Job No.: 12615338
Borehole / Sample No.: BH01 / SYD23-0328-01
Test Method: AS4133.4.1

Accredited for compliance with
ISO / IEC 17025 - Testing
Laboratory Accreditation No. 679

Authorised Signatory: D. Brooke
Date of issue : 18/07/23

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL.

Test Results

Depth (m)	Test Type (D,A,I)	Dimensions				Results				Sample Description		
		D (mm)	L (mm)	W (mm)	De (mm)	Load, P (kN)	Failure Mode (1,2,3..)	Is (MPa)	Is_{50} (MPa)	Rock Type	Structure	Moisture
15.15	D	49.5	54.0		49.5	0.32	3	0.13	**0.13**		refer core log	As Rec'd
	A	51.7		49.5	57.1	0.24	5	0.07	**0.08**		refer core log	As Rec'd
15.78	D	51.3	36.6		51.3	0.21	3	0.08	**0.08**		refer core log	As Rec'd
	A	35.6		51.3	48.2	0.38	3	0.16	**0.16**		refer core log	As Rec'd
16.23	D	51.8	39.3		51.8	0.24	3	0.09	**0.09**		refer core log	As Rec'd
	A	24.7		51.8	40.4	0.91	3	0.56	**0.51**		refer core log	As Rec'd
16.81	D	51.8	41.1		51.8	3.33	3	1.24	**1.26**		refer core log	As Rec'd
	A	40.4		51.8	51.6	5.9	3	2.21	**2.25**		refer core log	As Rec'd
17.24	D	51.8	47.9		51.8	3.98	3	1.48	**1.51**		refer core log	As Rec'd
	A	28.3		51.8	43.2	4.89	3	2.62	**2.45**		refer core log	As Rec'd
17.62	D	51.8	39.2		51.8	1	3	0.37	**0.38**		refer core log	As Rec'd
	A	36.7		51.8	49.2	8.12	3	3.35	**3.33**		refer core log	As Rec'd
18.23	D	51.9	49.1		51.9	4.21	3	1.56	**1.59**		refer core log	As Rec'd
	A	43.4		51.9	53.6	6.36	3	2.22	**2.29**		refer core log	As Rec'd
18.82	D	51.9	41.4		51.9	6.12	3	2.27	**2.31**		refer core log	As Rec'd
	A	38.7		51.9	50.6	8.87	3	3.47	**3.49**		refer core log	As Rec'd
19.06	D	52.0	50.4		52.0	6.36	3	2.35	**2.39**		refer core log	As Rec'd
	A	49.4		52.0	57.2	12.06	3	3.69	**3.92**		refer core log	As Rec'd
19.94	D	52.0	46.6		52.0	6.16	3	2.28	**2.32**		refer core log	As Rec'd
	A	37.9		52.0	50.1	8.26	3	3.29	**3.29**		refer core log	As Rec'd

Comments (if applicable):

MOISTURE
(W) Wet
(M) Moist
(D) Dry
(AD) As Drilled
(AR) As Received

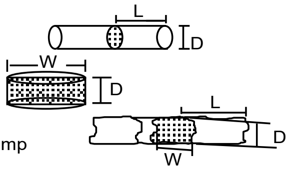
ROCK TYPE
(SS) Sandstone
(ST) Siltstone
(SH) Shale
(G) Granitic
(MSS) Meta Sandtone
(MST) Meta Siltstone
(-)

STRUCTRUE
(MA) Massive
(BE) Bedded
(IB) Interbedded
(LA) Laminated
(CR) Crystalline
(refer refer core logs

FAILURE MODE
1 = Fracture through fabric oblique to bedding
2 = Fracture along bedding
3 = Fracture through rock mass
4 = Fracture influenced by pre-existing:
(J) Joint plane, (M) Microfracture, (F) Foliation, (V) Vein
5 = Partial fracture or chip (Invalid result)

TEST TYPES

D = Diametral
A = Axial
I = Irregular Lump



L > 0.5 D
0.6W < D < W
0.6W < D < W

Time Since Sampling = n/a Days
Storage:
☒ CORE BOX ☒ UNDER COVER
☐ WRAPPED ☐ OPEN AIR
☒ UNWRAPPED ☐ UNKNOWN

Sampled By: Client
Date Sampled: not suppliued
Tested By: ET
Date Tested: 14/07/23

Sydney Laboratory
Unit 5 / 43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax: (02) 9462 4710

Point Load Strength Index - Report

Report No: SYD2301757
Issue No: 1

Client: BHM Geotechnical
Project: Material Evaluation
Location: Not supplied
Job No.: 12615338
Borehole / Sample No.: BH02 / SYD23-0328-02
Test Method: AS4133.4.1

Accredited for compliance with
ISO / IEC 17025 - Testing
Laboratory Accreditation No. 679

Authorised Signatory: D. Brooke

Date of issue : 18/07/23

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL.

Test Results

Depth (m)	Test Type (D,A,I)	Dimensions				Results				Sample Description		
		D (mm)	L (mm)	W (mm)	De (mm)	Load, P (kN)	Failure Mode (1,2,3..)	Is (MPa)	Is_{50} (MPa)	Rock Type	Structure	Moisture
15.39	D	52.0	51.5		52.0	0.85	3	0.31	**0.32**		refer core logs	As Rec'd
	A	33.6		52.0	47.2	1.23	3	0.55	**0.54**		refer core logs	As Rec'd
15.56	D	52.0	45.8		52.0	0.23	3	0.09	**0.09**		refer core logs	As Rec'd
	A	43.8		52.0	53.9	1.59	3	0.55	**0.57**		refer core logs	As Rec'd
16.75	D	55.0	60.6		55.0	0.07	3	0.02	**0.02**		refer core logs	As Rec'd
	A	45.0		55.0	56.1	0.1	3	0.03	**0.03**		refer core logs	As Rec'd
16.89	D	51.9	33.3		51.9	1.28	3	0.48	**0.48**		refer core logs	As Rec'd
	A	30.0		51.9	44.5	1.3	3	0.66	**0.62**		refer core logs	As Rec'd
17.26	D	52.0	52.6		52.0	0.25	3	0.09	**0.09**		refer core logs	As Rec'd
	A	37.9		52.0	50.1	0.57	3	0.23	**0.23**		refer core logs	As Rec'd
17.78	D	52.0	50.2		52.0	2.33	3	0.86	**0.88**		refer core logs	As Rec'd
	A	41.3		52.0	52.3	3.42	3	1.25	**1.28**		refer core logs	As Rec'd
18.19	D	52.0	45.3		52.0	3.45	3	1.28	**1.30**		refer core logs	As Rec'd
	A	41.7		52.0	52.5	7.35	3	2.66	**2.72**		refer core logs	As Rec'd
18.79	D	52.0	37.4		52.0	3.26	3	1.21	**1.23**		refer core logs	As Rec'd
	A	36.0		52.0	48.8	2.32	3	0.97	**0.96**		refer core logs	As Rec'd
19.12	D	52.0	43.2		52.0	8.62	3	3.19	**3.24**		refer core logs	As Rec'd
	A	42.0		52.0	52.7	13.01	3	4.68	**4.79**		refer core logs	As Rec'd
19.61	D	52.0	41.4		52.0	4.18	3	1.55	**1.57**		refer core logs	As Rec'd
	A	39.3		52.0	51.0	11.01	3	4.23	**4.27**		refer core logs	As Rec'd

Comments (if applicable):

MOISTURE
(W) Wet
(M) Moist
(D) Dry
(AD) As Drilled
(AR) As Received

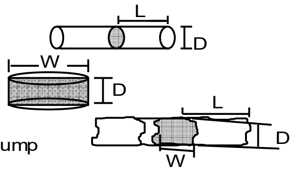
ROCK TYPE
(SS) Sandstone
(ST) Siltstone
(SH) Shale
(G) Granitic
(MSS) Meta Sandtone
(MST) Meta Siltstone

STRUCTRUE
(MA) Massive
(BE) Bedded
(IB) Interbedded
(LA) Laminated
(CR) Crystalline
(refer

FAILURE MODE
1 = Fracture through fabric oblique to bedding
2 = Fracture along bedding
3 = Fracture through rock mass
4 = Fracture influenced by pre-existing:
(J) Joint plane, (M) Microfracture, (F) Foliation, (V) Vein
5 = Partial fracture or chip (Invalid result)

TEST TYPES

D = Diametral
A = Axial
I = Irregular Lump



L > 0.5 D
0.6W < D < W
0.6W < D < W

Time Since Sampling = n/a Days
Storage:
☒ CORE BOX ☒ UNDER COVER
☐ WRAPPED ☐ OPEN AIR
☒ UNWRAPPED ☐ UNKNOWN

Sampled By: client
Date Sampled: not supplied
Tested By: ET
Date Tested: 14/047/23

Sydney Laboratory
Unit 5 / 43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax: (02) 9462 4710

Report No: SYD2301758
Issue No: 1

Point Load Strength Index - Report

Client:	BHM Geotechnical
Project:	Material Evaluation
Location:	Not supplied
Job No.:	12615338
Borehole / Sample No.:	BH03 / SYD23-0328-03
Test Method:	AS4133.4.1

NATA
Accredited for compliance with
ISO / IEC 17025 - Testing
Laboratory Accreditation No. 679

Authorised Signatory: D. Brooke

Date of issue : 18/07/23

Test Results

Depth (m)	Test Type (D,A,I)	Dimensions				Results				Sample Description		
		D (mm)	L (mm)	W (mm)	De (mm)	Load, P (kN)	Failure Mode (1,2,3..)	Is (MPa)	Is_{50} (MPa)	Rock Type	Structure	Moisture
8.21	D	51.9	49.1		51.9	1.83	3	0.68	**0.69**		refer core logs	As Rec'd
	A	37.7		51.9	49.9	1.37	3	0.55	**0.55**		refer core logs	As Rec'd
8.50	D	52.1	53.1		52.1	1.95	3	0.72	**0.73**		refer core logs	As Rec'd
	A	49.8		52.1	57.5	2.62	3	0.79	**0.84**		refer core logs	As Rec'd
9.20	D	52.0	47.3		52.0	1.9	3	0.70	**0.72**		refer core logs	As Rec'd
	A	35.3		52.0	48.3	1.28	3	0.55	**0.54**		refer core logs	As Rec'd
9.84	D	52.3	50.4		52.3	0.39	5	0.14	**0.15**		refer core logs	As Rec'd
	A	35.3		52.3	48.5	0.55	3	0.23	**0.23**		refer core logs	As Rec'd
10.42	D	52.1	51.6		52.1	1.46	3	0.54	**0.55**		refer core logs	As Rec'd
	A	31.9		52.1	46.0	3.4	3	1.61	**1.55**		refer core logs	As Rec'd
10.75	D	52.1	51.3		52.1	0.69	3	0.25	**0.26**		refer core logs	As Rec'd
	A	30.3		52.1	44.8	3.94	3	1.96	**1.87**		refer core logs	As Rec'd
11.06	D	52.0	52.0		52.0	2.05	3	0.76	**0.77**		refer core logs	As Rec'd
	A	49.2		52.0	57.1	2.06	3	0.63	**0.67**		refer core logs	As Rec'd
11.68	D	52.0	43.6		52.0	1.23	3	0.45	**0.46**		refer core logs	As Rec'd
	A	24.3		52.0	40.1	1.16	3	0.72	**0.65**		refer core logs	As Rec'd
12.56	D	52.0	50.6		52.0	1.61	3	0.60	**0.61**		refer core logs	As Rec'd
	A	48.4		52.0	56.6	3.2	3	1.00	**1.06**		refer core logs	As Rec'd
12.89	D	52.1	43.3		52.1	2.18	3	0.80	**0.82**		refer core logs	As Rec'd
	A	41.7		52.0	52.5	1.96	3	0.71	**0.73**		refer core logs	As Rec'd

Comments (if applicable):

MOISTURE

(W)	Wet
(M)	Moist
(D)	Dry
(AD)	As Drilled
(AR)	As Received

ROCK TYPE

(SS)	Sandstone
(ST)	Siltstone
(SH)	Shale
(G)	Granitic
(MSS)	Meta Sandtone
(MST)	Meta Siltstone

STRUCTRUE

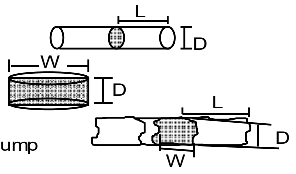
(MA)	Massive
(BE)	Bedded
(IB)	Interbedded
(LA)	Laminated
(CR)	Crystalline
(refer	

FAILURE MODE

1 = Fracture through fabric oblique to bedding
2 = Fracture along bedding
3 = Fracture through rock mass
4 = Fracture influenced by pre-existing:
(J) Joint plane, (M) Microfracture, (F) Foliation, (V) Vein
5 = Partial fracture or chip (Invalid result)

TEST TYPES

D = Diametral
A = Axial
I = Irregular Lump



L > 0.5 D
0.6W < D < W
0.6W < D < W

Time Since Sampling = n/a Days
Storage:
☒ CORE BOX ☒ UNDER COVER
☐ WRAPPED ☐ OPEN AIR
☒ UNWRAPPED ☐ UNKNOWN

Sampled By:	client
Date Sampled:	not supplied
Tested By:	ET
Date Tested:	14/07/23

Sydney Laboratory
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Fax: (02) 9462 4710

Point Load Strength Index - Report

Report No: SYD2301758
Issue No: 1

Client: BHM Geotechnical
Project: Material Evaluation
Location: Not supplied
Job No.: 12615338
Borehole / Sample No.: BH03 / SYD23-0328-03
Test Method: AS4133.4.1

Accredited for compliance with
ISO / IEC 17025 - Testing
Laboratory Accreditation No. 679

Authorised Signatory: D. Brooke

Date of issue : 18/07/23

Test Results

Depth (m)	Test Type (D,A,I)	Dimensions				Results				Sample Description		
		D (mm)	L (mm)	W (mm)	De (mm)	Load, P (kN)	Failure Mode (1,2,3..)	Is (MPa)	Is_{50} (MPa)	Rock Type	Structure	Moisture
13.19	D	52.1	34.4		52.1	1.1	3	0.41	**0.41**		refer core logs	As Rec'd
	A	32.0		52.1	46.1	1.3	3	0.61	**0.59**		refer core logs	As Rec'd
13.83	D	52.2	49.4		52.2	3.83	3	1.41	**1.43**		refer core logs	As Rec'd
	A	45.1		52.2	54.7	5.03	3	1.68	**1.75**		refer core logs	As Rec'd
14.36	D	52.0	36.7		52.0	1.94	4(J)	0.72	**0.73**		refer core logs	As Rec'd
	A	29.5		52.0	44.2	1.08	5	0.55	**0.52**		refer core logs	As Rec'd
14.48	D	52.3	31.8		52.3	2.2	3	0.80	**0.82**		refer core logs	As Rec'd
	A	28.1		52.3	43.3	3.29	3	1.76	**1.65**		refer core logs	As Rec'd
14.87	D	52.0	51.8		52.0	1.52	3	0.56	**0.57**		refer core logs	As Rec'd
	A	38.4		52.0	50.4	1.63	3	0.64	**0.64**		refer core logs	As Rec'd
15.28	D	52.0	37.6		52.0	0.69	3	0.26	**0.26**		refer core logs	As Rec'd
	A	33.5		52.0	47.1	0.99	3	0.45	**0.43**		refer core logs	As Rec'd
15.87	D	52.0	40.8		52.0	1.63	3	0.60	**0.61**		refer core logs	As Rec'd
	A	38.5		52.0	50.5	2.53	3	0.99	**1.00**		refer core logs	As Rec'd
16.29	D	52.0	42.8		52.0	0.34	3	0.13	**0.13**		refer core logs	As Rec'd
	A	30.7		52.0	45.1	0.79	5	0.39	**0.37**		refer core logs	As Rec'd
16.95	D	52.2	45.5		52.2	0.88	3	0.32	**0.33**		refer core logs	As Rec'd
	A	33.7		52.2	47.3	1.98	3	0.88	**0.86**		refer core logs	As Rec'd

Comments (if applicable):

MOISTURE
(W) Wet
(M) Moist
(D) Dry
(AD) As Drilled
(AR) As Received

ROCK TYPE
(SS) Sandstone
(ST) Siltstone
(SH) Shale
(G) Granitic
(MSS) Meta Sandtone
(MST) Meta Siltstone

STRUCTRUE
(MA) Massive
(BE) Bedded
(IB) Interbedded
(LA) Laminated
(CR) Crystalline
(refer

FAILURE MODE
1 = Fracture through fabric oblique to bedding
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TEST TYPES

D = Diametral
A = Axial
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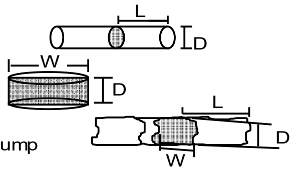


L > 0.5 D
0.6W < D < W
0.6W < D < W

Time Since Sampling = Days
Storage:
☐ CORE BOX ☐ UNDER COVER
☐ WRAPPED ☐ OPEN AIR
☐ UNWRAPPED ☐ UNKNOWN

Sampled By:
Date Sampled:
Tested By:
Date Tested:

Sydney Laboratory
Unit 5 / 43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax: (02) 9462 4710

Point Load Strength Index - Report

Report No: SYD2301758
Issue No: 1

Client: BHM Geotechnical
Project: Material Evaluation
Location: Not supplied
Job No.: 12615338
Borehole / Sample No.: BH03 / SYD23-0328-03
Test Method: AS4133.4.1

Accredited for compliance with
ISO / IEC 17025 - Testing
Laboratory Accreditation No. 679

Authorised Signatory: D. Brooke
Date of issue : 18/07/23

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL.

Test Results

Depth (m)	Test Type (D,A,I)	Dimensions				Results				Sample Description		
		D (mm)	L (mm)	W (mm)	De (mm)	Load, P (kN)	Failure Mode (1,2,3..)	Is (MPa)	Is_{50} (MPa)	Rock Type	Structure	Moisture
17.26	D	52.0	28.8		52.0	0.92	3	0.34	**0.35**		refer core logs	As Rec'd
	A	24.7		52.0	40.4	2.5	3	1.53	**1.39**		refer core logs	As Rec'd
17.91	D	51.9	36.3		51.9	1.89	3	0.70	**0.71**		refer core logs	As Rec'd
	A	33.6		51.9	47.1	3.95	3	1.78	**1.73**		refer core logs	As Rec'd
18.10	D	52.0	38.2		52.0	2.45	3	0.91	**0.92**		refer core logs	As Rec'd
	A	35.6		52.0	48.5	3.28	3	1.39	**1.37**		refer core logs	As Rec'd
18.94	D	51.9	46.6		51.9	3.32	3	1.23	**1.25**		refer core logs	As Rec'd
	A	44.8		51.9	54.4	3.86	3	1.30	**1.35**		refer core logs	As Rec'd
19.22	D	51.9	50.8		51.9	2.64	3	0.98	**1.00**		refer core logs	As Rec'd
	A	51.0		51.9	58.1	3.11	5	0.92	**0.99**		refer core logs	As Rec'd
19.35	D	51.9	43.5		51.9	2.31	3	0.86	**0.87**		refer core logs	As Rec'd
	A	40.9		51.9	52.0	3.93	3	1.45	**1.48**		refer core logs	As Rec'd
19.76	D	52.0	31.7		52.0	1.08	3	0.40	**0.41**		refer core logs	As Rec'd
	A	27.8		52.0	42.9	1.94	3	1.05	**0.98**		refer core logs	As Rec'd

Comments (if applicable):

MOISTURE

(W)	Wet
(M)	Moist
(D)	Dry
(AD)	As Drilled
(AR)	As Received

ROCK TYPE

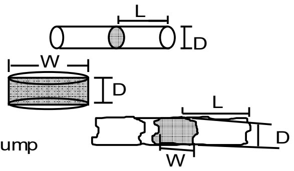
(SS)	Sandstone
(ST)	Siltstone
(SH)	Shale
(G)	Granitic
(MSS)	Meta Sandtone
(MST)	Meta Siltstone

STRUCTRUE

(MA)	Massive
(BE)	Bedded
(IB)	Interbedded
(LA)	Laminated
(CR)	Crystalline
(refer	

FAILURE MODE
1 = Fracture through fabric oblique to bedding
2 = Fracture along bedding
3 = Fracture through rock mass
4 = Fracture influenced by pre-existing:
(J) Joint plane, (M) Microfracture, (F) Foliation, (V) Vein
5 = Partial fracture or chip (Invalid result)

TEST TYPES



D = Diametral — L > 0.5 D
A = Axial — 0.6W < D < W
I = Irregular Lump — 0.6W < D < W

Time Since Sampling = n/a Days
Storage:
☒ CORE BOX
☒ UNDER COVER
☐ WRAPPED
☐ OPEN AIR
☒ UNWRAPPED
☐ UNKNOWN

Sampled By: client
Date Sampled: not supplied
Tested By: ET
Date Tested: 18/07/23